

U.S. VIRGIN ISLANDS

ST. THOMAS

**ST. THOMAS HARBOR AND WATERFRONT
AREA OF PARTICULAR CONCERN
(APC)**

A COMPREHENSIVE ANALYTIC STUDY

September 21, 1993

**VIRGIN ISLANDS DEPARTMENT of
PLANNING AND NATURAL RESOURCES**
Coastal Zone Management Program

Roy E. Adams
Commissioner

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TABLE OF CONTENTS**

1.	INTRODUCTION	1
1.1	General	1
1.2	Relationship to Other Plans and Regulations	2
1.3	Historical Perspective and Overview	3
	1.3.1 Pre-Columbus Settlement	3
	1.3.2 Colonial Period: 1672-1947	4
1.4	Other Classifications	10
2.	DESCRIPTION OF THE SITE	12
2.1	APC Boundary	12
2.2	Ownership Summary	12
2.3	Physical Environment	13
	2.3.1 Climate	13
	2.3.2 Geological Setting	13
	2.3.3 Hydrological Setting	15
	2.3.4 Coastal Environment	16
2.4	Biological Environment	16
	2.4.1 Terrestrial	16
	2.4.2 Marine	17
	2.4.3 Endangered Species	18
2.5	Cultural Resources	19
	2.5.1 Prehistoric	19
	2.5.2 Historic	20
2.6	Built Environment	22
	2.6.1 Roads and Ports	22
	2.6.2 Water Systems	23
	2.6.3 Wastewater Systems	24
	2.6.4 Energy Systems	24
	2.6.5 Solid Waste Disposal Systems	24
3.	RESOURCE USE, USE CONFLICTS, AND ADVERSE IMPACTS	
3.1	Resource Use	25
3.2	Use Conflicts	30
3.3	Adverse Impacts	33
	3.3.1 Water Quality	33
	3.3.2 Air Quality	35
	3.3.3 Noise Pollution	35
	3.3.4 Impacts on Biological Resources	35
	3.3.5 Impacts on Cultural Resources	36

4.	MANAGEMENT RECOMMENDATIONS	37
4.1	Policy Framework	37
4.2	Planning and Permitting	43
4.3	Legislative Change	63
4.4	Institutional Development	64
5.	CONCLUSION	65

LIST OF KEY ACRONYMS

Area of Particular Concern	APC
Base Flood Elevation	BFE
Coastal Barriers Resource System	CBRS
Coastal Zone Management Act	CZMA
Combined Sewer Overflow	CSO
Department of Housing, Parks, and Recreation	DHPR
Department of Planning and Natural Resources	DPNR
Department of Public Works	DPW
Division of Archeology and Historic Preservation	DAHP
Division of Coastal Zone Management	CZM
Division of Environmental Enforcement	DEE
Division of Environmental Protection	DEP
Division of Fish and Wildlife	DFW
Federal Emergency Management Agency	FEMA
Historic Preservation Commission	HPC
Mean High Water	MHW
Million Gallons Per Day	MGD
National Flood Insurance Program	NFIP
National Park Service	NPS
Sewage Treatment Plant	STP
Significant Natural Area	SNA
Territorial Pollutant Discharge Elimination System	TPDES
U.S. Army Corps of Engineers	USACOE
U.S. Coast Guard	USCG
U.S. Department of Agriculture	USDA
U.S. Environmental Protection Agency	USEPA
U.S. Fish and Wildlife Service	USFWS
U.S. Geological Survey	USGS
West Indian Company	WICO

LIST OF FIGURES

1. Regional APC Map
2. APC Boundary Map
3. Historic Dredge Sites
4. Long Bay Fill
5. CBRS Sites
6. 100-year Floodplain

7. Major Drainage Basins
8. Prevailing Currents
- 9a. Physical/Biological Environment (East)
- 9b. Physical/Biological Environment (West)
10. Vegetation of Hassel Island
11. Benthic Communities
12. Historic District
13. Proposed Anchor Zones
- 14a. Land Use (East)
- 14b. Land Use (West)
- 15a. Land Use/Opportunities and Constraints (East)
- 15b. Land Use/Opportunities and Constraints (West)
16. Proposed One-Way Loop
- 17a-d. Zoning Maps

1. INTRODUCTION

1.1 General

The St. Thomas Harbor and Waterfront is one of 18 Areas of Particular Concern (APC's) designated by the Planning Office in 1979 after public nominations and comment had been received (Figure 1). Located on the south central shore of St. Thomas, the harbor is one of the finest and most scenic, sheltered, deep draft harbors in the Caribbean region, and is the focal point of much trade, commerce, and touristic enterprise for the Territory. The waterfront serves as the corridor for the movement of people, goods, and bulk supplies between the urban center of Charlotte Amalie and destinations beyond via marine transport. Two small islands, Water Island (500 acres) and Hassel Island (135 acres), lie within St. Thomas Harbor and offer important historic, scenic, and recreational values. In addition to these two offshore islands, the Area of Particular Concern (APC) encompasses the area from Frenchman's Reef to Havensight; Long Bay and the downtown waterfront; Frenchtown and vicinity; Crown Bay; and Krum Bay (Figure 2).

The history of the Harbor and waterfront is varied and colorful (section 1.3) and the area has steadily grown in both capacity and use since its early days as a working port in the late 16th century. Today, St. Thomas Harbor is the principal port-of-call for more than 0.5 million tourist cruise ship passengers arriving in the Territory each year. As both the seat of territorial Government and the center of a vigorous duty free trade and other commercial services, Charlotte Amalie is a bustling and growing urban center, whose transportation efficiencies and "user friendliness" for visitors and residents alike demand increasing attention by professional planners and managers, if the gentrification, pollution, urban decay, and congestion of similar cities and ports elsewhere are to be avoided.

On July 26th, 1991, the CZM Commission adopted the 18 APC's recommended in the Final Environmental Impact Statement (USDOC, 1979), which accompanies the Virgin Islands CZM Act. The Final Environmental Impact Statement notes "the importance of the entire coastal zone," but declares that "certain areas are of yet greater significance." It also establishes the criteria for the designation of Areas of Particular Concern which are as follows:

- Significant Natural Areas
- Culturally Important Areas
- Recreation Areas
- Prime Industrial and Commercial Areas
- Developed Areas
- Hazard Areas
- Mineral Resource Areas

In September of 1991, the Coastal Zone Management (CZM) Commission met and held public hearings on all three islands on the boundaries of all 18 APC's. The Commission met again on October 1, 1991 and, based upon public input and staff recommendations, approved the boundaries of the APC's.

APC management requires knowledge of an area's historical development and traditional uses, and an action-oriented plan for the area's future utilization. This Comprehensive Analytic Study and proposed Management Plan is intended to serve as the overall planning and management framework within which the various regulatory entities carry out their respective decision-making authorities.

The APC planning effort recognizes that permit decision-making is most often reactive; that is, the decision to approve or disapprove a proposed development is made in response to a permit request, not in advance of it. The general goal of developing an APC management framework is to be able to make *a priori* decisions about the allowable extent of modification of an entire landscape unit. In other words, to raise the level of decision-making from the site-specific to that of natural landscape units and the maintenance of a wide array of interactive resource uses.

1.2 Relationship to Other Plans and Regulations

The St. Thomas Harbor and Waterfront APC Comprehensive Analytic Study and proposed Management Plan was prepared under the authority of the Coastal Zone Management Commission. The Study and proposed Management Plan is intended to serve as the overall planning and management framework within which the various planning and regulatory entities carry out their respective authorities. It is intended that the policy framework contained herein be incorporated into the policies and review criteria of those entities, including, but not limited to, the Department of Planning and Natural Resources (DPNR), the Department of Housing, Parks and Recreation (DHPR), the Port Authority, the Water and Power Authority (WAPA), the Department of Public Works (DPW), the National Park Service (NPS), the U.S. Fish and Wildlife Service (USFWS), the U.S. Army Corps of Engineers (USACOE), the U.S. Environmental Protection Agency (USEPA), and the Department of Property and Procurement. This Study and proposed Plan will serve as a guide for future decisions concerning the area. Future development activity should be consistent with the Study and proposed Plan.

The intent of this Study and proposed Plan is for all participating territorial and federal agencies to utilize the broad policy framework to guide planning and permit decisions with respect to their own authorities. For those agencies that issue permits or review and comment on permit applications, the Study and proposed Plan do not eliminate the authority of those agencies, but increases the predictability and timeliness of the permitting process since many

of the issues that must be addressed in a specific permit application are already addressed in the Study and proposed Plan.

The issues surrounding any proposed use or activity within the coastal environment are complex. A proposed use immediately outside the boundary of the APC planning area may result in significant adverse impacts on the APC and impair the goals of the APC management framework described herein. This Plan contains several different forms of guidance, all of which should be considered in evaluating impact on an APC. Both the individual property owner who is considering a specific proposal and the decision-maker who is evaluating the proposal should follow the guidance of this Plan.

1.3 Historical Perspective

The St. Thomas Harbor and waterfront has a rich and fascinating history. This deep, natural, irregularly shaped harbor with its surrounding green hills forms an almost perfect protective anchorage. It also provides the setting for the town of Charlotte Amalie, an historically popular and convenient port of call for vessels passing through the Caribbean or seeking a coaling station, a harbor of refuge, provisioning, repair services or an exchange of cargo. In more recent times it has become host to a steady flow of tourist laden cruise ships from every major maritime nation of the world. As a truly international entrepot, Charlotte Amalie, the "town which serves the port" has long had a reputation as a cosmopolitan maritime commercial center in the Caribbean, more sophisticated than some neighboring urban ports twice its size elsewhere in the region.

The following historical sketch is, although somewhat lengthy, a necessary precursor to a full understanding of the many diverse user groups that have played a part in the development of the St. Thomas Harbor and adjacent Charlotte Amalie area. (For more detailed accounts of the Harbor's development and history, see Gjessing, 1980; Jarvis, 1944; and Tyson, 1986.)

1.3.1 Pre-Columbus Settlements

The first known inhabitants in the Charlotte Amalie area were non-agricultural hunters, gatherers, and fisherfolk. These Indians, referred to as the preceramic, Archaic, or Meso-Indians (Marsh, 1981) lived in small camps along the shores and subsisted primarily on seafood. Remains of their early campsites, dating from approximately 3500 years ago, have been found in Krum Bay.

It is believed that the Meso-Indians were displaced sometime around 1900 years ago by groups that came to the Virgin Islands from the Orinoco River basin of Venezuela through the Lesser Antillean archipelago. They were the first inhabitants of the Virgin Islands to fabricate pottery and to practice agriculture. Some evidence of their settlements has been found on Water Island and Hassel Island as well as buried under Mainstreet in Charlotte

Amalie. Sites in other segments of the harbor were long ago obliterated by the intensive development of much of the shoreline areas.

The next group of inhabitants in the Charlotte Amalie area were the Carib Indians, who arrived from South America approximately 900 years ago. The Caribs fished, hunted, and practiced agriculture. By the beginning of the 16th century when Europeans began visiting the island in earnest, the Indian population had apparently disappeared (Tyson, 1986). The impact of their agricultural practices on the land, however, was apparent in that almost all of the primary or indigenous plant life on Hassel Island, and most likely around their other settlements as well, had been replaced with secondary growth (National Park Service, 1983).

The possibility exists, however, that other sites within the APC may yet remain undiscovered and undisturbed. Known prehistoric sites on Hassel Island and Water Island, and any new sites identified over time in the APC, must be recognized as invaluable and irreplaceable resources and need to be given adequate research attention and protection.

1.3.2 Colonial Period: 1672-1947

Settlement and Growth: 1672-1800

Although Columbus claimed St. Thomas for Spain in 1493, and the island was visited by seafarers seeking food, water, shelter, and a place to repair their vessels over the following centuries, no settlement was established on the island until the late 1600's. Initial attempts by Dutch, English, and Danes to settle the harbor basin in the 1650's and 60's were unsuccessful. It was not until 1672 that Denmark, through the Danish West India Company, succeeded to establish a permanent settlement on St. Thomas, and secure permanent colonial control of the island and its prestigious harbor. To ensure its control, the Company developed and fortified the waterfront; it erected Fort Christian (1680), the towers on Blackbeard's and Bluebeard's Hills (1679 and 1689 respectively), and small batteries on the southern ends of Hassel Island and Muhlenfels Point (1688). In 1681, four taverns were built to the west of Fort Christian, resulting in the town's original name of "TapHus" or Beer Hall.

The Danes originally planned to create a plantation economy, parcelling out the land surrounding the Harbor and the fort for that purpose. At one time, most of St. Thomas was cultivated for growing sugar cane and cotton (Dalton, *et al.*, 1982), but maritime trade rather than agriculture became the basis for the Harbor economy. The deep, naturally protected Harbor became a principal stop for trading vessels from all nations. The maritime trade-based economy greatly influenced the town's original layout. The large trading companies that were headquartered in Charlotte Amalie, along with Fort Christian, dominated the town. Warehouses were constructed along Main Street (Dronningens Gade) and the narrow, parallel streets north of town were developed with close-set shops, houses, warehouses, and churches.

The Harbor trade added a dynamic and colorful character that greatly influenced the culture, customs, and lore of the island. Initially, trade centered around the plantations. Visiting ships exchanged supplies and slaves for plantation products such as sugar, cotton, indigo, and tobacco. As mentioned, agriculture did not develop into the expected primary economic focus. A by-product of a plantation-based economy did, however, become one of the island's most financially lucrative businesses. The slave trade in St. Thomas evolved from the importation of slaves for use on St. Thomas plantations, to a slave market that was at one time the island's most profitable enterprise (Jackson, 1985). This trade lasted from the initial settlement in 1672 through 1848, when slavery was abolished in the Danish West Indies.

Early on in the island's history pirates, buccaneers, and smugglers were among those "merchants" that frequented the Harbor, with the encouragement of the Danish West India Company. Pirates openly disposed of their goods in town and often resided in the surrounding hills. While bringing great wealth to the town, they also discouraged legitimate trade from St. Thomas until the early 1700's, when the Danes began to promulgate policies encouraging trade throughout the island.

Early eighteenth century Danish policies encouraged legitimate trade and immigration to St. Thomas, and helped to stimulate the Harbor's economy and growth into a cosmopolitan town. In 1724, the West India Company officially declared the Harbor open to all shipping on payment of low import and export duties. Denmark also maintained neutrality in the various wars and fighting among the nations of Europe, and took a tolerant attitude toward the practice of various religions on St. Thomas. These three factors had the effect of attracting trade and immigrants from many European countries and other Caribbean islands, creating an affluent, rapidly expanding population in Charlotte Amalie.

The Harbor economy prospered, primarily in times of war, due to Danish neutrality. At various times throughout history, privateers from warring nations used the Harbor as a transshipment point, while at the same time merchant ships pursued by those privateers could use the Harbor as a safe haven to escape them (Tyson, 1986).

Charlotte Amalie's boundaries and population expanded throughout the eighteenth century; immigrants from around the world and planters from around the island moved to the town and became merchants and traders. "Urban slaves" (Tyson, 1986) in Charlotte Amalie, had more opportunities and exposure to European culture than their counterparts on plantations and on other, more agriculturally oriented islands. Their greater chance for independence is reflected in the growth of Charlotte Amalie's free black population throughout the 18th century, most of whom worked in maritime and skilled trades in town (Tyson, 1986). (For more information on the free black population of the Virgin Islands, see Marsh, 1981.)

Charlotte Amalie's eclectic social mix included transient seafarers and traders, merchants from many different nations, free blacks, slaves, and people escaping religious persecution in

other countries. The growing population spread the town's boundaries in all directions. Many French Huguenot families, fleeing religious persecution in Europe and French Islands, settled north of town, in the area known as Frenchmen's Hill. In the 1760's, "Savanne" (Savan) to the west of town, and "East Savanne" to the east of Government Hill were developed as residential areas for the growing number of free blacks, Catholics, Jews, and Huguenots. The area surrounding the Fort (which was originally a wetland) and the lagoon areas along the waterfront were filled in 1781-82, although these were not developed for many years.

Prosperity and Misfortune: 1800-1875

In 1801-02, and again in 1807 (until 1815), Great Britain occupied St. Thomas; Denmark had forfeited her neutrality in the Napoleonic Wars. During their occupations, the British Army constructed Cowell's Battery and a number of other structures on Hassel Island (which at that time was a peninsula of the main island known as Estate Orkanhullet, or Hurricane Hole). Besides Fort Christian, the Harbor's defenses consisted of a few small fortifications and a gun battery built by the Danish West Indian Company on Hassel Island and Muhlenfels Point.

After Denmark regained control over the island in 1815, harbor trade and activity continued to expand and prosper. The population increased rapidly, as did the number of stores, warehouses, and dwellings in town. The period between 1815 and 1875 was one of prosperity for the Harbor's maritime community. Not only was the town a primary center for trade in the Caribbean, it also became a regional communication center (Tyson, 1986).

The Royal Mail Steam Packet Company of Great Britain established a major maritime facility with coaling, provisioning, and repair facilities on Hassel Island in 1839. With the steamships came thousands of passengers needing accommodations and in 1840 the Grand Hotel, St. Thomas' first "tourist facility" opened. Shortly thereafter, St. Thomas Marine Repairing Slip (later Creque's Boatyard) was opened on Hassel Island, and a lighthouse was erected on Muhlenfels Point. Four steamship companies established their operations in St. Thomas Harbor between 1863 and 1873.

The rapid economic growth and prosperity resulting from these developments provided jobs for skilled and unskilled workers. Main Street merchants amassed great wealth, and many urban slaves were able to purchase their freedom before emancipation in 1848. Their prosperity led to the formation of a middle class, working segment in the formerly wealthy/owner-poor/slave dichotomous society. Slave emancipation in 1848 led to an exodus of workers from the countryside into town, and in many areas of town, especially Savan, already overcrowded conditions were made worse.

In 1860, a community of Frenchmen from St. Barth's was established on St. Thomas, with the farmers settling primarily on the northside of the island, and fishermen at the western end

of the Harbor (Frenchtown). These growing immigrant populations pressed the town's boundaries outward in all directions, including seaward through land filling.

Although the Harbor economy flourished during this period, its health and environmental quality were in serious jeopardy. A series of disasters plagued Charlotte Amalie through the 1800's, many with devastating results directly attributable to the rapid growth of the town's population and the lack of appropriate planning. Narrow streets, barely separated wooden houses and buildings with overhanging upper stories, and poor sanitary conditions resulted in a disease-ridden town, and severe environmental degradation of the Harbor.

Six fires, between 1804 and 1831, destroyed virtually the entire commercial area and much of the outskirts of Charlotte Amalie. The first fire destroyed more than 600 buildings (Jackson, 1985). The then Governor General of the Danish West Indies, B.F. Muhlenfels, had previously been an engineer and city planner. His plans, along with those of the Mayor of St. Thomas, Peter von Scholten, who had also studied city planning, were incorporated into the rebuilding of the town. Streets were widened and houses were built in accordance with specific design, spacing, and height controls to prevent a similar disaster in the future. The efforts were unsuccessful, however, and in 1806 two more fires destroyed more than 800 buildings. After these fires, insurance companies would not insure wooden structures so merchants began reconstructing with "fire-proof" buildings.

The new buildings had masonry walls, timbered rafters, brick roofs, brick-lined doorways, copper sheeted doors, and brick stairways. They ran the length of the city block extending north to south along the Harbor and included large, open courtyards so that flames could be controlled in the event of a fire. The buildings opened on to the Harbor so that cargo could go directly from the ships to the warehouses. The fire-proof buildings proved extremely successful, and the design was followed by many merchants, although the design was not mandated at this time.

Another fire in 1825 destroyed about 1000 buildings in town and the lower section of Savan, and prompted an official building code to be enacted. The code restricted the height and proximity of wooden buildings, but was still inadequate; a fire in 1826 destroyed all of the buildings around the lower section of Norre Gade, Kings Quarter, and damaged Frederick Lutheran Church.

After the sixth fire, in 1831, a more restrictive building code was finally put into effect. This code prohibited wooden structures on either side of Dronningens and Kronprindsen Gades (Main Street) from the Catholic Church to the eastern end of the street, and on the south side of Wimmelskafts Gade (Back Street). Buildings to the north of Back Street had to have at least a masonry facade and the other walls had to be laid with tile or slate. All new construction had to have roofs covered with fire-resistant materials such as brick, tiles, or

slate. Eventually, sheet metal was substituted since it was more suitable under hurricane conditions (Jackson, 1985).

The building code of 1832 was successful; there has not been another similarly devastating fire in Charlotte Amalie since then. Because of this tragic history, and the subsequent design and codes for the streets, alleys, buildings and structures in town, most buildings in Charlotte Amalie date from 1806 to 1832. The warehouses that now house the many stores along Main Street are living history, providing examples of early urban planning and building design.

Besides the devastating fires, the combined effects of the high population density, the constant influx of immigrants, poor sanitation systems, and natural disasters, created very unhealthy living conditions in town. This is dramatically illustrated by the number of epidemics that decimated the town's population, especially in the mid to late 1800's (Ragster, 1986). Charlotte Amalie experienced a yellow fever epidemic (1817), small pox epidemics (1827-28, and 1843), two cholera epidemics (1853-54 and 1867-68), and a malaria epidemic (1853) all during a time of rapidly growing prosperity. St. Thomas earned a reputation as a dirty, disease ridden port because of the frequent and severe epidemics it experienced.

The conditions that led to these outbreaks were worsened by a severe drought in 1822, nine serious hurricanes between 1819 and 1871, and an earthquake followed by a 27-foot high tsunamis in 1867. [Another tsunamis hit in 1918, killing 116 people and causing \$4 million dollars worth of damage (USGS, 1984a)]. These natural disasters sank over 100 ships in the Harbor (Ragster, 1986). The increased number of vessels visiting the Harbor, the introduction of steamships, and the extensive coaling and repair facilities established around the enclosed Harbor had some obvious negative effects on the Harbor ecosystems. Increased turbidity and high nutrient and bacterial concentrations, coupled with poor circulation (due to the single, narrow entrance to the channel, the number of wrecks within the Harbor, and the input of land-based pollutants and runoff) raised concerns among local residents, who urged the Danish authorities to improve the situation (Ragster, 1986).

In an effort to increase circulation and improve the water quality of the Harbor, a narrow channel was cut between the Harbor and Gregerie Channel in 1865, creating Hassel Island. At the same time, reefs and shoals in the central Harbor were blasted and dredged to accommodate larger steamships (Figure 3). The increased circulation from these modifications in the Harbor was expected to alleviate its unsanitary condition and improve the population's health and the Harbor's environmental health. Nevertheless, a tsunamis occurred in November of 1867, and shortly thereafter Charlotte Amalie once again experienced a major epidemic, this time a cholera outbreak that claimed 1200 lives (Gjessing, 1980).

The modification of the Harbor, establishment of a Quarantine Station at Muhlenfels Point in 1869, new building codes, and developments in sanitation and hygiene all combined to improve the health and environmental quality of Charlotte Amalie by the turn of the century.

Economic Decline: 1875-1947

Technological advancements that enabled the establishment of direct shipping and communication links between Europe and the Caribbean led to a decline in the Harbor's importance to international trade. After 1875 most of the steamship companies moved from St. Thomas, and although repair and coaling activities continued, the volume of trade was dramatically reduced (Tyson, 1986). Between 1880 and 1930, the town's population decreased by 40 percent. The middle class that began to form in the 1860's and 70's virtually disappeared, and employment opportunities fell. Even during this period of decline, the Harbor was undergoing many changes.

In 1916, the United States purchased the Danish West Indies from Denmark, primarily to gain control of the strategically important Harbor. From 1917 until 1931, the U.S. Navy operated a small station on Hassel Island. Other than that, the U.S. made little or no effort to improve the Harbor physically or financially. In 1937, efforts were made to attract cruise ships and stimulate the Harbor economy, but World War II interrupted their initial success.

The Harbor was developed into a wartime outpost; old military installations around the Harbor were renovated, a Navy submarine base was established at Crown Bay (hence, the name Sub Base), and the Army established a small base with underground fortifications on Water Island.

The newly formed West India Company (WICO) built their dock and shipping facility at Long Bay using dredge spoils from the inner Harbor adding approximately 50 acres of waterfront land to the island (Ragster, 1986) [Figure 4]. Haulover Cut was dredged to 7 feet and the spoils used to fill in the shoreline around the Chart House, Avery's Marina, and the Frenchtown Ballpark. Sub Base was developed when a portion of Crown Bay was filled with dredge spoils from the northwest shore of Gregerie Channel in 1943.

In 1947, the Naval Base at Crown Bay closed down. The end of World War II marked the end of one of the lowest periods in the Harbor's history.

Tourism and Development: 1950 - Present

Following World War II, a tourist economy emerged on St. Thomas that restored the Harbor to a regional center for commerce. While much of the yacht charter industry has relocated to the East End of St. Thomas (for a variety of reasons discussed in the Mangrove Lagoon/Benner Bay APC Comprehensive Analytic Study and proposed Management Plan), the shopping district, cruise ship base, and economic hub of the island is still located primarily in the St. Thomas Harbor and waterfront area of Charlotte Amalie.

The Harbor has undergone numerous, often drastic changes over the last three decades. In 1951, the old waterfront and wharfs were removed to construct the Waterfront Highway, or Veteran's Drive as it is also known today. The mud hole and Ballast Island at the western end of the inner harbor were the source of fill for the road. Water Island was leased to a private corporation for a tourist development in 1952; that lease expired in December 1992.

Other recent alterations to the Harbor include: the dredging of the central Harbor to fill land at Long Bay and Crown Bay in 1962-63; dredging of the eastern part of the Harbor from Muhlenfels Point to Havensight in 1966 (for sand to be used in building materials); and the construction of Frenchman's Reef Hotel at Muhlenfels Point in 1972. In 1986, a segment of the old U.S. Navy dock area in Crown Bay was filled by the V.I. Port Authority for a new cruise ship dock and marina complex. Further, and despite substantial community protest, 7.5 acres of Long Bay were filled by WICO in 1987 (see Nixon, 1990, for a complete history of the Long Bay controversy).

The changes and development of the Charlotte Amalie APC have often progressed at a faster rate than our knowledge and understanding of their impacts. There have certainly been some benefits from this "progress", including an improvement in water quality in the Harbor since 1972. Many of the Harbor's natural, historical, and cultural resources have been unwittingly destroyed, irrevocably lost, or are deteriorating daily. Despite these changes, the Harbor today retains much of its historic character; numerous warehouses, churches, and residence of the town are registered with the National Registry of Historic Places. There are undoubtedly prehistoric sites as yet undiscovered, and with proper attention, many of the old military fortifications, and marine industry structures could be restored, or at least stabilized.

The historic and cultural resources of the Harbor provide Virgin Islanders with a much needed and valuable link with their past, sustaining them culturally as well as economically. Effective and appropriate planning for its future development and management are necessary and, in the face of continued, rapid expansion of Charlotte Amalie, are urgently needed.

1.4 Other Classifications

Two sites within the APC are included in the Federal Coastal Barrier Resources System (CBRS): (1) Sprat Bay, a shallow bay on Water Island with moderate coral development and seagrass cover, and a salt pond within an undeveloped watershed (site VI-26); and (2) South Limestone Bay, a stretch of shoreline which protects a small salt pond on the east-central portion of Water Island (site VI-27) [Figure 5].

The Federal Coastal Barrier Improvement Act of 1990 established areas in the USVI as part of the CBRS. The purpose of the system is threefold (Island Resources Foundation, 1986):

1. To halt development in low-lying areas subject to natural disasters (i.e., flooding, hurricanes, etc.);
2. To stop wasteful federal expenditures in these areas; and
3. To protect valuable natural resources from being destroyed by unwise economic development.

By law, federal expenditures (e.g., grants, loans, federally backed insurance, etc.), including federal flood insurance, are prohibited for development projects within a designated CBRS site. The law does not, however, prevent projects from moving forward with private backing. Certain exemptions are allowable for park lands, recreational areas, public recreation infrastructure, and land acquisition.

Virtually the entire shoreline of the APC, and portions of several watersheds upland from the APC boundary, is situated within a designated 100-year floodplain (section 2.3.3) [Figure 6].

The southeast shore of Water Island, from Sprat Point to Flamingo Point and including Limestone Bay, has been designated as part of the proposed Virgin Islands Marine Reserve System. Type II and Type III activities are indicated. Type II activities specify that no anchoring may occur of vessels greater than 40' length, and no fishing of reef species. Type III activities specify that any size vessel may anchor, but no fishing of reef species. The proposed Marine Reserve System for St. Thomas and St. John was submitted to the Governor for signature in the early 1990's, however, no action has been taken pending completion of a similar effort and submittal covering proposed sites on St. Croix.

With the adoption of the territorial Coastal Zone Management Program in 1979, one site within the APC was identified as a potential Significant Natural Area (SNA): the southern tip of Water Island, known as Flamingo Point. The area provides nesting sites for the locally endangered Red-billed Tropicbird (*Phaethon aethereus*); White-tailed Tropicbird (*P. lepturus*) is also found in the area (pers. comm., J. Pierce, DPNR/DFW). An effort to survey and describe the major biological attributes of SNA's was initiated in 1989 by the DPNR/CZMP. However, the project was terminated prior to completion, and as of yet no official designation of SNA sites has occurred.

Both Hassel Island and Water Island are essentially owned by the Federal Government. The National Park Service administers 122.5 acres of the 135 total acres of Hassel Island (section 2.1). The southernmost third of Hassel Island (48 acres) is a Historic District listed on the National Register of Historic Places. Water Island, and the federally owned portion of Hassel Island, is considered "federally excluded" land under the CZMA, meaning it is not subject to provisions of the V.I. Coastal Zone Management Act. Both islands are included, however, in this planning framework for the St. Thomas Harbor and Waterfront APC.

2. DESCRIPTION OF THE SITE

2.1 APC Boundary

The boundary for the St. Thomas Harbor and Waterfront APC, established by the Coastal Zone Management Commission in October 1991, is described as follows (Figure 2):

Beginning at Muhlenfels Point, the boundary follows the ridge line in a northeasterly direction to Route 315; then follows Route 315 northerly to the intersection of Routes 30 and 315; then follows Route 30 westerly to the intersection of Routes 30 and 304; then follows Route 304 southwest to where it intersects with the road that leads to Mosquito Point; then continues southerly to the ridge line; then south along the ridge line to Mosquito Point; then due south past Water Island to the shelf edge or three mile limit (whichever is closer); then east along the shelf edge or three mile limit to a point directly south of Muhlenfels Point, then north to Muhlenfels Point, the point of origin.

2.2 Ownership Summary

As mentioned above, the Federal Government owns Water Island and a large part of Hassel Island. Of Hassel Island's 135 total acres, 122.5 acres are federally owned and administered by the Department of Interior, National Park Service (NPS). The lands were acquired between 1978 and 1982 when the U.S. Congress appropriated purchasing funds. By early 1993, the NPS had expected to have completed work on a General Management Plan pertaining to the protection and management of the many historical structures and scenic/recreational values of Hassel Island, and has plans to establish an advisory group to guide such efforts (pers. comm., M. Koenings, NPS). The remainder of Hassel Island is comprised of V.I. Government holdings and private land and structures.

Water Island is federally owned, but has been leased to Water Island Hotel and Beach Club, Inc. since the mid-1960's. That lease expired in December 1992, and the Federal Government has offered existing residents the opportunity to purchase land (*Daily News*, 1992b). In late 1992, the Federal government was exploring alternatives to relinquish its administrative oversight of Water Island. In preparation for the decision, the Federal government commissioned several surveys in 1992, including a survey of the island's fish and wildlife, historic sites, and land values. Due to complexities in the lease arrangements, title of the Federal portion of the island was retained by the Federal government until all problems are rectified.

The Charlotte Amalie waterfront is comprised of land and facilities owned by both the public and private sectors. A major public sector landholder along the waterfront is the Port Authority, which manages the waterfront dock facilities from Kings Wharf to Frenchtown and

in Crown Bay (Figures 14a and 14b). The Government also owns and controls a large portion of Krum Bay, where the Water and Power Authority desalination and power generating facilities, and a DPW equipment maintenance yard, are located.

2.3 Physical Environment

2.3.1 Climate

Rainfall in the Virgin Islands generally increases with increasing elevation and exhibits a general trend on each island of a dry-to-wet cline from the east-to-west. Average rainfall data, compiled from several years of records at various stations can be misleading in that it probably poorly represents the available precipitation at a particular area in any given year. The U.S. Virgin Islands receive an average of 41 inches of rain per year (Bowden, 1970). The wettest months are September to December; the dry season is February to July (Island Resources Foundation, 1977).

The St. Thomas Harbor APC, including Water Island and Hassel Island, receives an average of 42 inches of rain per year, while Charlotte Amalie receives approximately 45 inches of rain per year. Most of this rainfall occurs during the wettest months (September to December), and usually occurs in brief, intense showers of less than a few tenths of an inch. More intensive rainfalls (storms which generate 8-12 inches of rain in a 24 hour period) can occur as well. The amount and intensity of rainfall can have a significant effect on salinity, turbidity, and the amount of pollutants carried into the harbor with stormwater runoff.

Temperatures average an annual 79 degrees Fahrenheit (F), with temperatures in the winter averaging 76 degrees F, and temperatures in the summer averaging 84 degrees F.

The Virgin Islands lie in the "easterlies" or "trade winds" which traverse the southern part of the "Bermuda" high pressure area; predominant winds are thus from the east-northeast and east (Island Resources Foundation, 1977). Trade winds average about 15 to 20 knots and vary seasonally, but most significantly during the late summer months when tropical depressions may form resulting in storms and/or hurricanes. Hurricane season is from June to November, with peak activity occurring in September. The annual probability of a hurricane event in the Territory is once every 16 years (Bowden, 1974).

2.3.2 Geological Setting

Harbor sediments are mostly derived from the erosion of upland soils, and are comprised mainly of quartz and feldspar sand, carbonate mud, and organic detritus. In addition, sediment composition is influenced by scouring and dredging of older submarine strata, biological productivity in the harbor, and other suspended solids washed into the harbor or

discharged at ocean outfalls. Fine carbonate sediments transported inward from deeper depths add to these deposits (Brill and Associates, 1991).

Sediment core samples taken from Krum Bay and Crown Bay indicate that the bay bottom is covered with a layer of unconsolidated calcareous mixture of shell, sand, and silt (USACOE, 1981). Several discontinuous layers of medium hard coralline limestone form the sediment layer, which ranges to more than 18 feet in thickness. Beneath the clay and calcareous materials lies hard igneous bedrock of volcanic and pyroclastic origin. Crown Bay is covered with a blanket of organic silt and clay (USACOE, 1981).

Historical seismicity in the USVI

As a result of convergence between the Caribbean and North American tectonic plates, the Virgin Islands are located in one of the most earthquake prone regions of the world. During the past 450 years, damage has occurred from earthquakes and associated tsunamis. Strong seismic shocks were recorded for the Virgin Islands in 1777, 1843, 1867, and 1918. Destructive tsunamis occurred in the U.S. Virgin Islands in 1867 and in 1918; the latter resulted in 116 deaths and economic losses estimated at \$4 million (in 1918 dollars) (USGS, 1984a). The 1867 tsunamis was reported to have a wave height of 27 feet above sea level (Geoscience Associates 1984b).

Potential human and economic losses for a similar event occurring today would be several orders of magnitude higher. Scientists report high seismic potential for a major fault rupture in the Puerto Rico Trench north of Puerto Rico and the Virgin Islands (USGS, 1984a). The Virgin Islands are classified as "Zone 4" for earthquake vulnerability, the highest damage zone and the same classification given to many parts of California (International Conference of Building Officials, 1988).

Studies prepared in 1984 estimated that an earthquake of MMVIII intensity (Modified Mercalli Scale) has a recurrence period of between 110 and 200 years for the St. Thomas/St. John area. The probability of such an earthquake occurring in the next twenty years is between 50 and 70 percent, and between 60 and 80 percent during the next 50 years (Geoscience Associates, 1984a and 1984b). The waterfront areas of Charlotte Amalie and Christiansted are especially vulnerable to impacts from earthquakes due to substantial construction on recently filled (reclaimed) land. It is these areas where liquefaction and ground settling are likely to be the greatest. Buildings constructed on loose alluvial or man-made fill soils along the waterfront are at risk of destruction should an earthquake occur (Geosciences Associates, 1984b). The majority of the waterfront area is built on reclaimed lands, with fill material deposited on top of an alluvial base (USVI Govt/DPNR, 1992a).

2.3.3 Hydrological Setting

The APC receives runoff from 13 drainage basins, the largest of which is 417 acres (BC&E/CH₂M Hill, 1979) [Figure 7]. The majority of these watersheds are intensively developed for residential and commercial use. Guts or drainage ditches collect rainfall runoff and deposit it downstream through ocean terminating culverts. Inland flooding, however, has been an increasing problem for the Charlotte Amalie urban area during the past three decades.

Urban development has altered or eliminated old drainage ditches resulting in increased flooding after even minor rainfall events. In Savan Gut, for example, construction has modified the drainage system and some structures have been constructed over the drainage gut (Brower and Beatley, 1988). As the urban center grew, concrete and other non-porous surface materials replaced natural vegetation, adding to the potential for sheet runoff and flooding. Undersized culverts and the general lack of maintenance of storm channels and culverts serve to compound flooding problems. Other contributing factors are the area's steep topography, non-porous rock base, and thin clayey soils.

While rains of 1-3 inches can result in flooding, heavy rains (storms which generate 8-12 inches of rain in a 24 hour period) can cause major problems for the Charlotte Amalie urban area. The worst of these storms occurred in April of 1983, when St. Thomas received rainfall of 2.5 inches per hour, and more than 16 inches in 18 hours. Parts of Charlotte Amalie were inundated with more than four feet of mud and flood water. Areas near the coast were the worst hit, as flood waters could not discharge into the ocean fast enough. Most businesses along Main Street were flooded with up to 4.7 feet of mud and water; one person died. A flood of this dimension can be expected to occur on the average less than once every 100 years (USGS, 1984b). However, in addition to this 1983 flood, other major flooding events for Charlotte Amalie in this century were recorded in 1916, 1960, 1969, and 1970 (USGS, 1973).

A-Zone floodplain exist throughout the APC (FEMA, 1992a and 1992b). A-Zones are, in general, comprised of 100-year riverine floodplain. In only some cases have Base Flood Elevations (BFE's) and flood hazard ratings within A-Zones been determined for the area, although the majority of the coastline is given a BFE of six feet. It should be noted that flood waters during the 1983 storm went well inland beyond the designated (mapped) floodplain.

2.3.4 Coastal Environment

Tidal range in the St. Thomas Harbor is generally less than 1.2 feet, with a mean range of 0.8 feet. Extreme low water occasionally reaches -1.0 foot below MLW, and extreme high water may reach +1.9 feet above MHW. The tide is primarily diurnal with one high and one low

tide each day during the spring range. The tide is mixed or semi-diurnal during the neap range (Island Resources Foundation, 1977; Percious, *et al.*, 1972).

The "tidal prism" is the amount of water entering and leaving the inner harbor during each tidal cycle. This is estimated at only 3.7 percent of the harbor volume. Thus, tidal action has a relatively small impact on the harbor water exchange. It would take 12-20 days to completely flush the harbor through tidal action alone (Brill and Associates, 1991). Other factors influencing flushing rates include wind drift and currents.

Currents are generally less than 10 cm/sec and average 4.8 cm/sec (about 0.09 knots) [Percious, *et al.*, 1972; Coulbourn, *et al.*, 1973]. The following description of general current patterns in the harbor is excerpted from Brill and Associates (1991):

The net circulation follows a broad pattern directed inward through the main entrance, counterclockwise through the harbor and westward through Haulover Cut into Crown Bay. Near surface movement follows this pattern and the near bottom current reverses daily, generally on the ebb tide, influenced by several forces including tide, wind, offshore currents, and harbor geometry. The relative intensities of these forces, at times opposing each other, control the speed and direction of flow and the timing and force of flow reversals (Figure 8).

Storm Hazards

In addition to hazards from inland flooding, earthquakes and tsunamis, coastal storms have exerted significant impacts on the St. Thomas waterfront during recorded history. Major tropical storms battered St. Thomas in 1867, 1871, 1916 (Brower and Beatley, 1988), and most recently in 1989. Storm surge wave activity is generally associated with such events, and can result in considerable loss to shorefront property and coastal infrastructure.

2.4 Biological Environment

Figures 9a and 9b depict the biological and physical environment of the APC.

2.4.1 Terrestrial

Remaining terrestrial vegetation within and adjacent to the APC is almost entirely of secondary growth, the result of previous plantation agriculture and development. Within the APC boundary, and other than that which is found on Water Island and Hassel Island, vegetation is limited mostly to the east end of the Harbor, along the Havensight to Muhlenfels Point stretch of coast, and along the drainage courses throughout. Brill and Associates (1991) provide some information on the plant species found at the proposed sites of the WICO developments at Long Bay and Liverpool Estate, otherwise little information exists on the

terrestrial vegetation of the area. The aforementioned study provides also few notes on the plants, shrubs, and trees that are of particular value for landscaping or preservation purposes.

Most of Hassel Island is vegetated with dry forest (Figure 10). The cliffs on the west support various cacti and century plants (Woodbury and Weaver, 1987; Dammann and Nellis, 1992).

Likewise, relatively little information exists which describes the location and status of the various groups of terrestrial vertebrates within the APC. Brill and Associates (1991) provide a list of animals observed (or likely to inhabit) the proposed WICO development sites at Long Bay and Liverpool Estate. The list includes 4 species of amphibians, 13 species of reptiles, 26 species of birds, and 8 species of mammals. Rare or endangered species are noted below (section 2.4.3).

Most mainland bird species are found on Hassel and Water Island. The green iguana, crested anole, barred anole, common ground lizard, dwarf gecko, and the Puerto Rican racer are present on both islands (Dammann and Nellis, 1992).

Of special interest is the fact that mongoose, reportedly, has not been introduced as yet to either Hassel Island or Water Island. These islands should receive extra attention and precaution in the implementation of future developments to avoid the introduction of alien species.

The south coast of Water Island provides nesting sites for the locally endangered Red-billed Tropicbird (*Phaeton aethereus*) and White-tailed Tropicbird (*Phaeton lepturus*).

2.4.2 Marine

Figure 11 depicts the shallow benthic communities of St. Thomas Harbor, from survey work completed in the early 1970's. Due to past and continued intensive growth and development of St. Thomas Harbor, its marine communities have been significantly altered. Marine organisms which can withstand the higher turbidity levels of the harbor due to nonpoint source runoff and propeller stirring of bottom sediments, continue to find suitable habitat (McComb Engineering, 1983). A recent study indicates that the benthic communities in the harbor are limited (Brill and Associates, 1991).

The McComb Engineering (1983) EAR for the dredging and filling of Long Bay provides brief descriptions of benthic habitat for four study zones within the harbor. Bottom substrate of the area near the WICO cruise ship dock and the immediate turning area to the southwest is comprised mostly of coarse materials dredged up from propeller and thruster wash. Mollusks and larger decapods are occasionally found here. Rupert Rock lies near the southern terminus of the WICO dock, and within the APC. Although the water is fairly turbid from propeller wash from the large cruise ships, the extensive submerged rock ridge

harbors numerous hard and soft coral species along with other invertebrates, the soft sediments have abundant populations of tube worms, and there are extensive manatee grass beds between Rupert Rock and the shore (pers. comm., B. Kojis, DPNR/CZMP).

The second zone identified includes the shallower inshore areas of Long Bay, including areas around pilings, along docks, bulkheads, and along the beach front. A greater diversity of marine flora and fauna was found here, as these waters were found to be generally cleaner and less turbid. A small variety of algae, attached invertebrates, and other fauna were identified; some scattered seagrass beds were also found.

The third zone studied included the narrow rocky zone of rip-rap protecting the seawall around Frederiksberg Point. Municipal sewage was previously discharged in the area, but the practice was halted in 1973. Marine communities have improved since then, and several species of small hydrozoan corals were identified, with Fire Coral (*Millepora spp.*) the dominant form. The fourth and largest benthic zone studied included the outer portion of Long Bay which is covered by varying thickness of silty sand. Burrowing forms of mollusks, crustaceans, and worms, which are more tolerant of turbidity, fine sediments, and low oxygen and light levels, were recorded. Plants found included sparse amounts of *Halophila* seagrass, and different species of the green alga *Caulerpa*.

2.4.3 Endangered Species

The U.S. Endangered Species Act defines "endangered species" to mean a species or subspecies that is in imminent danger of extinction throughout all or a significant portion of its range. "Threatened species" are those likely to become endangered in the foreseeable future unless current trends are reversed. Such species are protected by Federal law; neither the whole animal or any products from it may be taken, sold, or possessed. Alteration of the habitat in which any of these species occurs may be, in certain cases, prohibited or constrained.

The V.I. Legislature has also passed endangered species legislation. Known as the Indigenous and Endangered Species Act of 1990, the bill (Act 5665) signed into law in December 1990, authorizes the Commissioner of DPNR to promulgate a list of endangered and threatened species in the Virgin Islands. The V.I. Government, Department of Planning and Natural Resources, Division of Fish and Wildlife maintains a list of locally endangered or threatened species. These species may be abundant elsewhere and are not, as yet, specifically protected by local or federal laws.

Of those animals listed by Brill and Associates (1991) as occurring, or likely to occur at least seasonally, at the WICO development sites at Long Bay and Liverpool Estate, the following species are listed as either federally or locally endangered (DPNR/DFW, 1991): Virgin Islands Tree Boa (*Epicrates monensis granti*); Green Sea Turtle (*Chelonia mydas*); Hawksbill

Sea Turtle (*Eretmochelys imbricata*); Brown Pelican (*Pelecanus occidentalis*); Antillean mango (*Anthracothorax dominicus*); Fisherman Bat (*Noctilio leporinus*); and Red Fruit Bat (*Stenoderma rufum*). Brill and Associates (1991) provide brief descriptions of the natural history and habitat requirements of these species. The federal listed endangered St Thomas Prickly Ash (*Zanthoxylum thomasianum*) may also occur at this site (pers. comm., R. Boulon, DPNR/DFW).

Of the above list, the Brown Pelican, the Green Sea Turtle, the Hawksbill Sea Turtle, and the Virgin Islands Tree Boa are federally listed endangered species.

Marine mammals are occasionally sighted within the APC. There have been at least three sightings of the federally listed endangered Humpback Whale (*Megaptera novaengliae*) in West Gregerie and East Gregerie Channels within the past decade, including a 1993 sighting of a humpback calf near the downtown waterfront. Dolphins are also not uncommon (pers. comm., R. Boulon, DPNR/DFW). A manatee was sighted in St. Thomas Harbor for three days in November 1988, and was later found dead at the south end of the WICO dock.

The Virgin Islands Tree Boa (*Epicrates monensis granti*) may also occur on Water Island.

2.5 Cultural Resources

The Virgin Islands, and the Charlotte Amalie area in particular, have experienced nearly 3500 years of human habitation. Sites containing artifacts that provide valuable insight and understanding of the islands' development, culture, and history can be found throughout the Territory. The St. Thomas Harbor and Waterfront APC is itself rich in the cultural remains associated with prehistoric and historic settlements, and marine trade. The structures, materials, and unique cultural and historical information these resources provide are increasingly recognized as important to Virgin Islanders, and are also potentially valuable assets for expanding the tourist economy. Cultural and historic sites serve as educational tools to help both the local population and visitors to understand the Virgin Islands today.

The following is an overview of some of the many cultural and historical treasures that exist within the APC; it is by no means exhaustive. Many prehistoric sites may still be undiscovered in this area, as in the entire Territory. Every project undertaken that excavates land, dredges the harbor floor, paves, bulldozes, erects a structure, or otherwise alters the landscape without first undergoing a comprehensive assessment is potentially destroying an irreplaceable piece of the islands' history.

2.5.1 Prehistoric

Specific information about known prehistoric settlement site remains can be obtained through DPNR's Archaeologist. Rather than state specific, known locations of these archaeologically

significant sites, it is more appropriate to simply state that most, low-lying protected coastal areas have a high probability of containing remnants from pre-Columbus Indian settlements. Geographic features, previous finds, and other information provide clues as to the most probable areas to locate these valuable resources.

Hassel Island, Water Island, Nisky, Sub Base, and Krum Bay all held, at one time, relics of these ancient settlements. Due to the nature and pace of development in these areas, numerous sites have most likely been lost, but at the same time, others may still exist. Rather than abandon efforts to find and preserve any remaining artifacts, future development plans and efforts should give priority to their discovery and protection, or, at the very least, to a proper survey and data recovery prior to destruction.

Three preceramic archaeological sites were designated (1976) as the Krum Bay Archaeological District. The three sites are unique in that they represent the earliest known human habitation of the northern Virgin Islands (Bullen and Sleight, 1963). They have been severely impacted by military, industrial, and road construction since the 1940's (Cultural Resource Group, 1988).

2.5.2 Historic

Buildings and Structures

The historic character of Charlotte Amalie is one of its most attractive features. The Waterfront is an Historic Landmark, and a large portion of the town falls into the Territorial Historic District (Figure 12). Monuments such as Fort Christian, the Legislature Building, the warehouses located from the Waterfront to Main Street, Market Square, and Bluebeard's Tower, the Lutheran Church, the Synagogue and at least 15 other key structures scattered throughout the Historic District are physical reminders of the island's rich history.

The historic buildings, monuments, and the town layout are neither mere relics of the past, nor a restored image of it, but are individual components of a working waterfront. Maintaining the delicate balance between history, character, and economic well-being requires that the community together with government planners carefully examine each proposed project in the broadest context.

Submerged Historical Resources

St. Thomas Harbor holds the remains of numerous wrecked vessels and their cargo. The increase in amateur divers and "treasure hunters" in recent years, along with the number of dredge and fill projects, has in some cases degraded historic wreck sites by uncontrolled excavation and souvenir taking. Local divers who dive the Harbor with regularity report that

relics that were at one time abundant in the Harbor, such as bottles and coins, are much more scarce today.

Military Structures

St. Thomas' military history and strategic importance are evidenced by the many structures still present on Hassel Island and around the Harbor. Fort Christian and the Legislature building are the most obvious of these former military structures, but many others are present as well. The ruins of a small defensive battery near Muhlenfels Point are clearly visible from the Harbor, and Frederiksfors (built in 1689) and a fortified tower north of town (built in 1678-79) are now the well recognized Charlotte Amalie sites of Blackbeard's and Bluebeard's Castles respectively.

Fortifications on Hassel Island were erected as defensive lines for Fort Christian. In 1779, Prince Frederik's Battery (now Fort Willoughby) was erected on the southeast point of Hassel Island. During Great Britain's occupancy in 1801, Cowell's Battery and many other structures -- barracks, storage buildings and bunkers -- were built on Hassel Island by the British Army. Shipley's Battery on the northern hill of the island and a few other structures were erected by the British Army during their second occupation between 1807 and 1815.

Although the majority of Hassel Island is under the jurisdiction of the National Park Service (except for a few private holdings next to the Royal Mail Inn Complex), the remaining structures of Fort Willoughby, the Garrison House (just north of Fort Willoughby) and Cowell's Battery are in holding of the Virgin Islands Government. Hassel Island is listed on the National Register of Historic Places.

Maritime Commerce and Trade

As discussed above (Section 1.2), Charlotte Amalie earned an early reputation as a "metropolitan" town, due largely to the maritime commerce that was central to the Island's development. The West Indian Company building in Havensight and the many warehouses along the waterfront are all functioning, modern pages of the Island's maritime commercial history.

Some of the most visible reminders of the Harbor's foundations in maritime trade and commerce are found on Hassel Island. Creque's Marine Railway, the Royal Mail Inn, and the St. Thomas Dock, Engineering, and Coaling Company are all visible reminders of the town's traditionally close ties with marine industry. These industries were central to the rapid growth of the Harbor, and were also the mainstay of the economy in the island's stagnant, recessionary period between 1870 and 1945.

All of these sites are listed in the National Register, and all are subject to some structural stabilization and/or renovation under the National Park Service's General Management Plan (1983) for Hassel Island.

2.6 Built Environment

2.6.1 Roads and Ports

The eastern portion of Long Bay contains the best equipped cruise ship facilities in the Lesser Antilles. These facilities, owned and operated by the West Indian Company, provide complete services for cruise ships, cargo vessels, fuel tankers, cable ships, military vessels, and research and geodetic survey vessels. Not all visiting ships wishing to utilize these facilities are able to do so, as demand often exceeds available dock space. Quite frequently, therefore, cruise ships and other large vessels must anchor outside the Harbor in an area known as the Outer Customs Anchorage (Area 4, Figure 13). Vessels anchored offshore must tender passengers to shore by launch, most often landing at Kings Wharf along the downtown waterfront. The only other available cruise ship dock facility on St. Thomas is located at Crown Bay, which is owned and operated by the Port Authority, and which receives fuel tankers, container vessels, and the occasional military vessel as well.

Facilities for small boats (of less than 150 feet) exist at several marinas located throughout the APC, especially at Long Bay (approximately 200 slips), Frenchtown, and Crown Bay (approximately 100 slips). Numerous yachts are moored or anchored in West Gregerie Channel adjacent to Water Island. In addition, the downtown waterfront area is managed by the Port Authority as the principal wharf area for merchant trading vessels, mini-cruise ships, fishing boats, inter-island ferries, tour boats, and large private yachts. The downtown waterfront bulkhead and apron play an important role in the daily commercial and cultural life of St. Thomas. The Port Authority's sea plane terminal and landing ramp are located close to Frenchtown.

Charlotte Amalie's main east-west vehicular thoroughfare, Veteran's Drive, parallels the waterfront bulkhead along most of the APC boundary. This is a four-lane highway west of Tolbod Gade, but from Fort Pladsen eastward is only a two-lane road. Veteran's Drive services the Charlotte Amalie downtown area, which in turn is comprised mostly of narrow, one-way streets. Traffic congestion occurs throughout the urban area almost daily during peak demand hours, and is exacerbated by curb parking.

Several improvements to the Charlotte Amalie traffic situation are either currently underway or in the planning stages, including:

1. Racetrack Road improvement project;

2. highway lighting improvements along Veteran's Drive from Crown Mountain Road to Lover's Lane;
3. widening of Lover's Lane from the waterfront to Racetrack Road; and
4. widening of Long Bay road to four-lanes from Lover's Lane to the Havensight entrance.

These improvements will include enlargements of box culverts (storm drain culverts) at several locations. Later, a bypass road will be constructed near Hospital Grounds to connect with Raphune Hill and relieve some of the congestion presently experienced around the Wheatley Center area. In addition, a climbing lane (third lane) is under design for Raphune Hill; a contract is underway to improve traffic signage and signals; and a (territorial) project to improve street signage (names) is in the design stage, but will require legislative approval before action (pers. comm., J. Gergler, DPW).

Another road traffic congestion problem exists around the Sub Base area where trucks servicing the vessels and industrial activity at Crown Bay comprise a large percentage of the traffic. A traffic improvement plan was prepared specifically for this area as part of the Crown Bay Masterplan, and the Department of Public Works is preparing to implement at least some of the recommendations of that study, including drainage improvements, bus pullouts, and pedestrian crosswalks and shelters (pers. comm., J. Gergler, DPW).

2.6.2 Water Systems

The principal sources of water on St. Thomas are desalinated seawater, rainfall collected from residential roof-top catchments, and groundwater. Public water supply and domestic and commercial self-supply are the principal uses.

The island's principal municipal power plant and seawater desalination plant are located in Krum Bay within the APC boundary. Waste heat from the thermoelectric facility is used by the nearby seawater desalination plant to produce a potable water supply for the majority of residents in Charlotte Amalie. Areas outside the public water supply system are self-supplied and augmented by water produced at the municipal desalination plant. At times in the past, supplemental fresh water has been barged from Puerto Rico, as well as collected by now defunct surface catchment systems. Groundwater use along the south shore of St. Thomas, from Krum Bay to Red Hook, is very limited, with saltwater intrusion a problem in some locales (USGS, 1984c).

The facility at Krum Bay is operated by the Water and Power Authority (WAPA); the Territory's public power generation and water production utility. With the installation of a new 1.4 MGD unit in December 1992, total production capacity at the desalination plant is currently 4.45 MGD (pers. comm., G. Rothgeb, WAPA).

2.6.3 Wastewater Systems

Most of Charlotte Amalie is served by a municipal wastewater collection and treatment system. The sewage treatment plant (STP) is located near the airport on Port Authority property. The outfall operates under a TPDES permit (No. VI 0020044), with allowable flow of 3.4 MGD (Tetra Tech, 1991a).

Relocation of the sewage treatment plant or improvement of the system is desirable as significant odors emanate from the lagoon-type treatment system that is used. Moreover, the plant resides on Port Authority land, and both they and the Federal Aviation Administration (FAA) are exerting pressure to have the plant relocated. The DPW must find a site nearby to minimize expense, and is assessing a site at Red Point peninsula as one possibility.

The DPW has cleaned the sewer line which runs along Veteran's Drive. A new, relocated pipe is required in the new Courthouse area. This project is underway. Department officials are aware of odor problems that exist along the downtown waterfront and indicate that the problem stems from a combination of inadequate sewer lines and poor housekeeping practices (i.e., cleaning of grease traps) by several businesses in the area. The DPW is currently planning a camera inspection and replacement program for the Charlotte Amalie sewer system (pers. comm., M. Cornwall, DPW).

2.6.4 Energy Systems

Power for St. Thomas and St. John is generated by the combined power and water production facilities at Krum Bay. The plant consists of two steam generating units, one diesel, three gas turbines, and four desalination units. A new 24 megawatts (MW) combustion turbine became operational in early 1993 (Rothgeb, 1993).

Power is generated by combustion of No. 6 and No. 2 fuel oils which are delivered by barge to a fuel pier and pumped to storage tanks. The fuel is drawn off as needed from the storage facilities to fire the combustion equipment. Total current power production capability is approximately 128 MW, while daily peak demand is approximately 63 MW. Growth projections for power demand indicate a peak demand of 77 MW by the year 2000 (R.W. Beck, 1988).

An underwater cable supplies power to St. John.

2.6.5 Solid Waste Disposal Systems

The Department of Public Works, Solid Waste Division, is responsible for the collection, transport, treatment (if necessary), and disposal of solid waste in the Territory. For most areas of the island, dumpsters are strategically located along main roads and residents are

responsible for disposing of household wastes at these locations. In a few limited areas, however (e.g., Tutu, Anna's Retreat, and parts of the Savan area in Charlotte Amalie) curbside refuse collection is provided by DPW. One problem with curbside collection is that trash is often found scattered by domesticated animals before it can be picked up (pers. comm., G. Patrick, DPW).

In all areas, business owners must provide their own arrangements for solid waste disposal, and private contractors are generally utilized in this regard. Those found dumping commercial solid waste in litter receptacles are subject to fines (in violation of Act 4176, Title 19, of the V.I. Code).

3. RESOURCE USE, USE CONFLICTS, AND ADVERSE IMPACTS

3.1 Resource Use

Figures 14a and 14b, depict the principal land uses of the APC.

The St. Thomas Harbor is comprised of 0.72 square miles (1.86 sq km) and includes two principal cruise ship anchorages (Figure 13):

1. Outer Harbor Anchorage (No. 4), at the harbor entrance on the southeastern edge of the main harbor; and
2. Long Bay, the primary anchorage and docking area in the northeastern sector (No. 3).

Small boat anchorages and marinas are also present, the largest (marina) of which is located in Long Bay with 200 slips for vessels up to 150 feet long and draft of 15 feet. Other marina facilities are located at Crown Bay and in the Frenchtown vicinity.

(A) Frenchman's Reef to Havensight

The major portion of this area is occupied by the West Indian Company (WICO) which includes the most extensive passenger and cargo ship handling facilities in the Virgin Islands. In 1990, the docks were extended to provide docking space for four cruise ships. A large marina and numerous small boat moorings are located adjacent to the dock area in Long Bay.

Because of the large number of cruise ships that call at St. Thomas, WICO and vicinity docks frequently are unable to accommodate all of the vessels requiring service. Cruise ships that cannot be accommodated at the dock are usually anchored in the outer harbor, and passengers are tendered by launch to Kings Wharf. Some cruise ships, however, regularly utilize the facilities at Crown Bay.

Also in this area at Muhlenfels Point is Frenchman's Reef Beach Resort, located on beachfront property. This was formerly the site of the old Flamboyant Hotel. The resort includes 525 guest rooms, multiple restaurants and lounges, meeting rooms, specialty shops, swimming pools, a health club, and watersport activities. Located adjacent to Frenchman's, and also owned by Marriott Corporation, is the Morningstar Beach Resort, having 96 rooms, tennis courts, and specialty shops literally within steps to the beach. The two facilities are serviced by on-site wastewater treatment and desalination plants.

Planned Developments

Havensight Road Development: The CZM permit authorizes the construction of nine commercial one-story buildings, conforming in height to existing buildings in the area, and consisting of 51,600 square feet.

Liverpool Estate Development: The CZM permit authorizes the construction of 153 condominium/hotel apartments and commercial space, consisting of 206,200 square feet, in four buildings varying from three to five stories in height in terraced structures, requiring creation of at least a one acre nature reserve on the site.

Rupert Rock Landfill: The CZM permit authorizes the placement of landfill of approximately 2.2 acres with no dredging, and the construction of 76 resort hotel rooms, two restaurants, and commercial space, consisting of a total of 73,200 square feet, in five buildings varying from one to three stories in terraced structures, together with two parking structures, two stories in height, containing 248 parking spaces to satisfy the parking requirements of both adjacent sites.

Rupert Rock Marina: The CZM permit authorizes the construction of a marina with 54 slips 80 feet or larger, with a floating breakwater.

(B) Long Bay and Downtown Waterfront

This portion of the waterfront extends from Paul M. Pearson Gardens to the inter-island ferry near Frenchtown and is used primarily for waterfront leisure and traditional commerce. An abandoned swimming pool which occupied waterfront property across from the Lucinda Millin nursing home has been removed, and the area is being leased to the Rising Stars Steel Pan Orchestra for a nominal fee of one dollar (\$1.00) per year (pers. comm., H. Dennis, DHPR). Tennis courts are being renovated. The dock facilities near the Legislature Building (Kings Wharf) are used by local fishermen for mooring and boat repair, and by the U.S. Coast Guard.

Port Authority owns and manages the waterfront bulkhead and apron from Kings Wharf to Frenchtown. It is utilized mostly by small to mid-size vessels (up to 100-200 feet in length).

Small, down-island trading vessels, private yachts, and tour boats are the principal users of this waterfront area. Because of vehicular traffic congestion, continued safe public access to the waterfront is compromised. Residents and visitors often experience difficulty in crossing Veteran's Drive in order to reach the trading vessels, the waterfront market, and other activities. A dock master (employed by Port Authority) oversees operations of the dock and apron along the downtown waterfront.

Most yachts utilize the slips, moorings, and services at various private marinas located throughout the harbor. DPNR is the responsible agency for managing small boat moorings.

Planned Developments

In 1987, 7.5 acres of submerged land in Long Bay were filled by WICO. Plans for this and other areas owned by WICO include the following (excerpted from Brill and Associates, 1991):

Long Bay Development: The CZM permit authorizes construction of five two-story commercial buildings for use as shops, offices, warehouses, and restaurants, consisting of a total of 136,200 square feet.

Long Bay Marina: The CZM permit authorizes construction of a 169 slip marina together with a government boardwalk and fishermen's tie-up, 350 feet long and 8 feet wide, along the front of the Government's land.

Several road improvement projects are currently underway or scheduled to begin in 1994, especially for the Long Bay area (section 2.6.1). Expansion plans for the waterfront area presently include the new Tortola Wharf and Terminal (for trading vessels bound for the BVI's), to be constructed in 1993 (pers. comm., D. Brin, Port Authority).

(C) Frenchtown and Vicinity

The waterfront area from the inter-island ferry and U.S. Customs facilities to Frenchtown is used for transportation services, traditional fishing and boating activities, a fish cleaning and market area, and for marina facilities. All of the fish offal from the fish cleaning operation is reportedly used for baiting fish traps. Most of the available shoreline is presently developed. The marina and adjacent waters are congested with vessel traffic, and surface runoff occasionally creates excessive turbidity. Haulover Cut, the man-made channel which separates Hassel Island from St. Thomas, is a navigational bottleneck for both boats and sea planes (when they are in operation). Currently, a helicopter service operates from the sea plane ramp.

Planned Developments

An application has been made to the V.I. Coastal Zone Committee and the U.S. Army Corps of Engineers to expand the dock at Avery's Marine in Frenchtown. This would extend the existing dock by 22 pilings, resulting in a new dock which would be 160 feet by 8 feet. The sea plane service is scheduled to resume operations in 1993, which will apparently displace the helicopter service now in operation at the same location.

(D) Crown Bay

Marina facilities at Crown Bay consist of 20 acres of filled land with bulkhead and finger piers. Several businesses lease premises from the Port Authority.

The Crown Bay area is one of the most heavily developed areas of the St. Thomas waterfront. The major shoreline uses in the area include container ship facilities, marina and cruise ship dock facilities, warehouses, restaurants, and various retail shops.

Crown Bay Marina occupies a large portion of the waterfront. The marina has 96 slips and a total of 5050 feet of dock, including a 315-foot fuel dock. The marina has several shops, a bar and restaurant, sightseeing and tour boats, and other facilities.

Also located in Crown Bay is Haulover Marina and associated drydock facility.

Planned Developments

Port Authority has no plans for imminent construction, although it is considering a longer-term project which would place additional fill and bulkhead along the Crown Bay waterfront from the Crown Bay Marina to Careem Hill. This would allow for more dock space to service deep draft vessels. The project is strictly conceptual at this point with no details available.

(E) Krum Bay

The Water and Power Authority (WAPA) electric generation and desalination plants occupy much of the Krum Bay shoreline. Bulk materials, especially sand and fuel, are unloaded and stored throughout the Bay. The Authority's sea water intake pipes are located near mid-Bay. All of the available shoreline is presently developed and much of the surrounding hillside is used for fuel and water storage tanks. The northeast section of Krum Bay is littered with derelict barges and other equipment that have been dumped or abandoned. DPNR "inherited" the problem when it took over the Krum Bay property; it has since removed some of the debris. Since 1988, the Department has been exploring options for removing the remaining

debris with assistance from the U.S. Army Corps of Engineers and the V.I. National Guard (pers. comm., J. Sutton, DPNR/DEE).

Other operations in the Bay include Devcon's sand barging (off loading) operations, and Domino Oil Company's fuel transfer operations (to nearby bulk storage facilities).

Planned Developments

DPNR has plans to construct a docking facility (not a marina) for DPNR vessels, and to improve some of the buildings to provide space for storage. There is also a (private) proposal to build a small marina in Krum Bay.

Devcon has a CZM permit that authorizes maintenance dredging in Krum Bay. Devcon's operations have caused shoreline accretion, resulting in a narrowing of the bay (pers. comm., B. Kojis, DPNR/CZMP).

A.P.C. Rentals operates mooring dolphins on submerged land in Krum Bay. The company applied for a minor CZM permit, but the Legislature failed to ratify the permit and so no permit was issued by DPNR. A NOVA was issued 11 January 1993 (pers. comm., B. Kojis, DPNR/CZMP).

(F) Hassel Island

Hassel Island is a small offshore island (135 acres); it is a resource of exceptional historic, cultural, natural, recreational, and scenic value. Because of its close proximity to Charlotte Amalie (150 feet across Haulover Cut), the island's development potential is high. Presently, the island receives few visitors and serves mainly to preserve the visual integrity of St. Thomas Harbor. The southernmost third of the island (48 acres) is a Historic District listed on the National Register of Historic Places. The island is owned largely by the Federal Government and is administered by the National Park Service.

Several possibilities for development exist, including:

1. refurbishment of the old Royal Mail Inn;
2. restoration of facilities at the old Creque Boatyard and Careening Cove, possibly for the development of a maritime academy to be administered by the Department of Education;
3. development and interpretation of historic resources (barracks, fortresses, etc.) scattered along the island's mountainous spine; and
4. removal of pilings remaining from pre-existing docks.

These and other possibilities are currently being assessed by NPS staff (pers. comm., M. Koenings, NPS). A first priority of any development plan for the island would have to deal with the present problems of limited ferry transport and dock facilities.

(G) Water Island

Water Island, southwest of the entrance to St. Thomas Harbor, is the fourth largest island in the Territory (500 acres). The island is owned by the Federal Government but is currently leased to Water Island Hotel and Beach Club, Inc. The lease expired in December 1992, and the Federal Government has offered existing residents the opportunity to purchase land (section 2.2).

Scattered development has occurred on Water Island, including hotels and private homes, especially of the estate type residential development. The V.I. Government wishes to see administrative oversight for the island relinquished to the V.I. Government following the December 1992 lease expiration date. Negotiations to that effect are apparently underway between the Federal Government and the V.I. Government.

In the 1950's, Water Island was used as a weapons testing and hazardous materials storage site (Potter, *et al.*, 1980). There has been some discussion of a possible clean up of known storage areas by the USACOE to begin sometime in 1993.

There is scheduled ferry service between Crown Bay Marina on St. Thomas to the public dock on Water Island. Many residents and visitors use their own transportation but water-taxi service to Water Island from Crown Bay Marina may also be arranged if needed.

3.2 Use Conflicts

The St. Thomas Harbor and Waterfront area has experienced phenomenal growth and development during the past three decades, and is today the focal point for a wide range of interests, some complementary and others not. Several important community needs -- especially those of recreational and leisurely enjoyment of the waterfront by all segments of society (e.g., youth, aged, and handicapped) -- are lacking. There are not enough opportunities for pedestrians to quietly sit and enjoy all that a tropical port and waterfront have to offer, with plenty of green space and appropriate landscaping to enhance the human qualities of the otherwise mostly concrete urban environment.

Use conflicts are many and diverse, and this Plan does not claim to describe them all. Nevertheless, the following is an attempt to identify some of the larger conflicts and, together with the next section on "adverse impacts", should serve to develop the perspective embodied in this Plan, that there is a degree of urgency for effective management of the St. Thomas

Harbor and Waterfront if significant, and in some cases irreversible, social, economic, and biological impacts are to be avoided or at least minimized.

For marine related activities, conflicts center around a limited resource -- a 0.72 square mile harbor -- that is not presently managed as if it was a limited resource. Continually, more cruise ships are invited to call into St. Thomas; more cruise ship facilities are planned; more passenger facilities, including hotels, commercial shops, restaurants and bars are planned; and more small boat marinas and associated shoreside facilities are planned.

This is not to argue that additional new developments are not desirable or feasible, but simply that the cumulative impact from these developments are not being identified, let alone addressed, with the result that "market forces" are allowed to lead and virtually decide upon the continued development of the harbor and waterfront. The conflict inherent in this is that other real or potential values of the harbor and waterfront are generally left out of the long-term development vision, especially those pertaining to the quiet enjoyment of the harbor by local residents, and the habitat needs (quality and quantity) of aquatic and wildlife species. Also left out is the protection and development of historic sites, including those pertaining to the harbor's maritime heritage.

The growing use of navigation channels has resulted in a compromise to public safety. While a major tragedy has thus far been avoided, several "close calls" are on record with Coast Guard officials and the Harbor Master. Sea plane service is scheduled to be reinstated (in 1993) at the Frenchtown air boat terminal (since its 1989 Hurricane Hugo demise); meanwhile a second sea plane service (for sightseeing tourists) has begun operations out of Long Bay.

Yachts and other small boats are forced to anchor further into West Gregerie Channel, adding to congestion and navigational safety concerns along that route. Dinghy traffic to and from Water and Hassel Islands and St. Thomas waterfront add to congestion. Meanwhile, the number of cruise ships visiting the Harbor has surpassed the number of available docking facilities, with the result that passengers must be tendered ashore in small launches. The lack of an efficient and coordinated anchorage management plan for the Harbor results in an avoidable increase in collision risk. All of these uses, and more, add to a growing potential for the occurrence of an accident involving the loss of life and/or property.

Conflicts also develop between polluters of the marine environment and those who derive their livelihood from it (often the same group of people). Marine debris washes ashore along St. Thomas, Hassel Island, and Water Island, partially as a result of ship-generated waste discarded at sea by cruise ship operators. (Fortunately, this problem has received considerable attention in recent years and appears to be improving.) Meanwhile, the yachting industry has recognized the need to do something about the array of vessel wastes poured regularly into the Harbor, but as yet there are no shoreside sewage pump-out or U.S. Department of Agriculture (USDA) certified solid waste reception facilities. As a result,

sewage, bilge water, solid waste, and other pollutants are routinely discharged into the marine environment with no development of the "user pays" philosophy to at least work towards a solution to these growing problems. For its part, Government has **not** set the example by providing similar or better facilities for its own ports and the many ferries that call into the Harbor.

The future development of Krum Bay is now at a cross roads. Numerous derelict ships and equipment litter the shoreline and bottom of Krum Bay. The large ships often crowd the bay preventing passage of smaller vessels. West Indies Transport Company currently operates a boat salvage and repair facility without a CZM permit. Conflicts currently exist between WAPA which draws water from Krum Bay for production of freshwater for St. Thomas and Devcon's sand barging operations and Domino Oil Company's fuel transfer to its bulk operations. WAPA's most serious problem is with the large quantity of sand and silt drawn into the Authority's intake systems forcing WAPA to perform numerous, costly unscheduled maintenance to the system. Further, the ever increasing number of uncontrolled activities in the bay creates a dangerous situation wherein an accidental incident with intake systems (structures, pumps, etc.) can easily occur (letter from D.C. Francois, WAPA, 1993).

Despite the overcrowded conditions in the bay, there are several current requests for permits to use the bay. These include a request by fishermen, who have traditionally used Krum Bay and who are organized under the name "Last Resort", who wish to repair a bulkhead and/or build a finger pier to dock, repair and maintain their vessels. A request by Mr. J. Cranston to develop a small boat facility to accomodate his vessel and other vessels adjacent to the DPNR/DEE facility. A request from Mr. E. Rabsatt to moor 3 or 4 ferries adjacent to parcel 176 Krum Bay. And finally a request by Mr. W. Hurst to moor a drydock near the mouth of the bay.

On the land side, traffic congestion has significantly eroded the historic character of Charlotte Amalie. Thus, the most obvious conflict -- between continued growth and preservation of historic character -- has yet to reach terms amenable to all.

In this regard, and although few would argue that shoreline filling is inherently a beneficial act towards the environment, there exists a dire need to resolve the longstanding traffic "bottleneck" problem along the waterfront at Frederiksberg Point. This stretch of two-lane road is the cause of daily traffic delays, adding to the Territory's consumption of fossil fuels and the unquantifiable loss of human productivity. If it is demonstrated that the only feasible solution is to create new land by filling along this limited stretch of waterfront and for this limited purpose, then such a compromise to serve a genuine public need should be earnestly pursued.

3.3 Adverse Impacts

3.3.1 Water Quality

In 1983, a study of water pollution sources in St. Thomas Harbor reported that "the discharge of pollutants from the urbanizing watershed, including large quantities of clays and silts, vehicle parts and tires, waste oils from vehicles and service stations, broken sewers, cleaning fluids, municipal wastes, restaurant wash water, and general street debris, contribute significantly to the continual harbor pollution" (Wernicke and Towle, 1983). It would appear, at least qualitatively, that the situation has improved little since the 1983 study. Field studies during this planning effort identified the same water pollution sources, which can be generally identified as the following five principal categories:

1. turbidity from sediment runoff and propeller wash;
2. sewage from leaking sewer pipes combined with stormwater flows through culverts;
3. sewage discharge from vessels;
4. solid waste discharge from vessels and from land-based sources; and
5. oil contamination from spills and/or deliberate dumping on land and water.

The cumulative impact from these water pollution sources has not been adequately quantified. A water quality monitoring program for the Harbor has not evolved into a consistent and statistically valid program, nor has the program demonstrated its intended monitoring goals and objectives.

As noted in section 2.3.4, general harbor flushing capacity is driven principally by wind and wave generated currents, and less by tidal action. The tidal prism is only 3.7 percent of the Harbor water volume. Surface currents enter the main harbor entrance, sweep past Pacquereau Bay and follow a net counterclockwise pattern through the Harbor (Dalton, *et al.*, 1982, as reported in Wernicke and Towle, 1983). The Harbor is designated as Class "C" waters under the Virgin Islands Water Quality Standards.

Propeller stirred sediments are a largely inescapable reality for a relatively shallow water port which services large, deep-draft vessels. The deposited fine sediments from past dredging activities are continually resuspended by propeller wash which occurs mainly near the large docks at Havensight and at Crown Bay. Currents carry the suspended sediments to other parts of the Harbor where they eventually settle out. The biological impacts of sedimentation are not fully understood, although several EAR's have noted that benthic communities in the Harbor are comprised of species more tolerant of turbidity and sedimentation (section 2.4.2). As for coral reefs, however, lethal and sub-lethal effects from sedimentation are well documented (Rogers, 1990).

Sewage leaking into stormwater drains enters the harbor at several points along the APC waterfront. Seven such sites were identified in the field as part of this study, both at natural drainage discharge locations (guts) and at stormwater culverts (Figures 15a and 15b). Many of these discharges occur or are made worse during periods of intense rains, but at least three such sites are reported to discharge raw sewage continuously into the marine environment (pers. comm., C. Crooke, DPNR/DEP). Most of these sites exhibit heavy algal growth and, especially at Krum Bay, intolerable stench. Although it is often difficult to identify with certainty the direct source of sewage contamination, at least one of the discharge points (a discharge pipe located at East Gregerie Channel in Frenchtown) is known to result from an improperly designed sewer line. Other sites are affected by the occasional bypass discharge of sewage from nearby pump or lift stations (pers. comm., C. Crooke, DPNR/DEP).

Wernicke and Towle (1983) describe the then extant water quality situation in St. Thomas Harbor, and provide data on vessel-generated sewage at various anchorages and mooring sites around the Harbor. While the report notes that additional, verifiable data and analysis are needed to guide priority action, it concludes that vessel sewage wastes are generally a minimal component of the overall pollution load in the Harbor. Nevertheless, and even at that time (a decade ago), vessel wastes, especially from anchored and/or moored live-aboard vessels, contributed significant Biological Oxygen Demand (BOD) levels and fecal coliform. That report recommended that sewage discharge from anchored/moored vessels should be eliminated due to the low flushing capability of the bay and current eddy in Long Bay.

Marine debris is evident throughout the Harbor and is derived from both land-based sources and vessels. Drainage guts deliver household and sometimes commercial solid waste to the Harbor with every significant rainfall, and scrap vehicles, appliances, and various machines can be seen at points along the waterfront. Several derelict vessels can be found at Crown Bay and Krum Bay. Once again, the cumulative impact from these sources is unknown, nor have the derelict vessels been surveyed to determine the nature and degree of their pollution potential. Krum Bay is particularly congested with a wide array of derelict vessels, vehicles, and abandoned structures that impinge on the Bay and its adjacent lands and submerged lands. Moreover, the Bay has very limited flushing capacity.

DPNR/DEP is involved in a committee with WAPA, Hess Oil Virgin Islands and the Gasoline Retailers Association, which includes Texaco Caribbean, Esso Virgin Islands and other major oil producers and suppliers, to create a meaningful plan for the collection and eventual burning of used oil by both WAPA and Hess.

Presently there are several sanctioned disposal sites on each island for receiving of petroleum product wastes. Business owners are asked to store waste oil on-site, in properly sealed containers with secondary containment devices. Secondary containment devices are required if it is determined that this storage is within the first tier of the coastal zone and is classified as a terminal facility.

The storage of waste oil is a growing problem for a number of businesses, especially the marina operators who receive relatively large quantities of waste oil from the boating industry and who have limited safe storage space on the marina site.

Waste oil is illegally discharged with regularity into drainage guts or storm sewers. As frequently as once every three months, 200-300 gallons of waste oil is dumped into the drainage gut which discharges at the Frenchtown fish market (pers. comm., C. Crooke, DPNR/DEP). Oil is a visible component of combined stormwater discharges at various points along the APC waterfront.

3.3.2 Air Quality

Legally, there are no "non-attainment areas" in the Territory with respect to compliance with National Ambient Air Quality Standards (NAAQS). Three areas, however, -- Christiansted, Southshore Industrial Area, and Charlotte Amalie -- are potential non-attainment areas and deserve further ambient air studies from an area-wide, cumulative impact perspective. There is a need for collection of ambient air quality baseline data at all three sites.

In Charlotte Amalie, air quality worsens considerably when trade winds stop or when the occasional thermal inversion occurs. Carbon monoxide from automobile exhaust is the most significant air quality problem for Charlotte Amalie, although sulfur dioxide emissions from ships is an important contributing factor. Large vessels contribute to the problem, although they are, by law, prohibited from discharging soot "in such quantities as to create a nuisance" [Title 12, V.I. Rules and Regulations, Chapter 9, Section 204-22 (c)]. It is the responsibility of DPNR/DEP enforcement officials to monitor the opacity of the smoke plumes emitted from large vessels at anchor in the Harbor. Exceedance of a percentage opacity of 40 percent specified in the Virgin Islands Rules and Regulations is grounds for the issuance of fines.

DPNR/DEP conducts ambient air quality monitoring (for inhalable particulate) from one station located on top of Fort Christian; another station will be established on top of another waterfront building (pers. comm., L. Spivak, DPNR/DEP); and a third at the Airport in 1993 (pers. comm., T. Linnio, DPNR/DEP).

3.3.3 Noise Pollution

Noise impacts are difficult to describe and quantify, as the type of noise in addition to its decibel level is used to determine if an adverse impact exists. An urban environment produces a broad range of noise types and levels. The St. Thomas Harbor APC lies directly beneath the take-off pattern for jets using the nearby airport.

Most of the noise impacts for this planning effort were identified by users of the waterfront, especially the live-aboard residents using the Long Bay and Crown Bay marinas. In the latter

area, the loading and unloading of container vessels and loud music emanating from nearby bars were identified as noise sources which keep people awake through the night.

No official Noise Ordinance exists within the Territory, although there is a Public Nuisance Ordinance that is occasionally used to deal with a specific noise problem. There is also a section of the Business Law (Chapter 11, Section 352a) which requires that businesses self-regulate noise levels beginning at 12:00 AM (midnight) throughout the week.

3.3.4 Impacts to Biological Resources

Section 2.4 describes the limited biological resources remaining in the APC as a result of historical developments in the Harbor and adjacent urban/industrial areas. Although there have been no recent systematic biological surveys in the Harbor (with the exception of as yet unpublished reports on Hassel and Water Islands by the National Park Service), it is likely that cumulative impacts from increased turbidity (a result of propeller wash and stormwater runoff) are exerting their continued adverse effects on benthic communities. There are several locations where sewage from leaking mixes with stormwater runoff and is discharged into the harbor. At these locations water quality is visibly degraded and, presumably, adversely affects habitat quality.

A few years ago there was a mysterious die-off of Pelicans around the island; several dead birds were found in the Long Bay area. Although the cause of the die-off has not been ascertained, it is believed that nearshore feeding seabirds, like Pelicans, are good indicators of an ecosystem's health (pers. comm., J. Pierce, DPNR/DFW).

3.3.5 Impacts to Cultural Resources

Section 2.5.1 describes the situation with respect to pre-historic sites within the APC. Several prehistoric sites have either been destroyed or are now covered by development. Nevertheless, the possibility will always exist for new finds, and so caution is required in the siting, facility planning, and review of earth change applications.

Changes to existing structures, or the construction of new structures, within the Historic District are subject to review and approval by the Historic Preservation Commission (HPC) of DPNR. For the most part, the creation of the Historic District, a result of the 1968 Historic Districts Act (No. 2258), has resulted in some continuing protection of these resources. But the Commission's power and resources, and the development control process in general, have not, despite good intentions, been sufficient to meet the required task. As a result, certain areas of the District, especially the buildings immediately facing the waterfront, have not maintained their historic character. The waterfront has succumbed to commercial forces with the result that a wide variety of commercial establishments, many having their own

"franchised" styles incorporated, now line the waterfront to the detriment of the District's general appearance.

Moreover, it is believed by at least some observers of the historic preservation review process, that the general lack of administrative procedures and internal review guidelines utilized by the Commission has resulted in piecemeal variance from general standards. For example, although the HPC must publish public notice of its meetings, its own rules allow only the adjacent landowners of a proposed development to speak or make comment on the proposal. If the proposal is to gain variance from height standards, for example, and the adjacent landowner would eventually like to do the same with his/her building, then his/her comments on the current proposal are likely to be highly favorable, resulting in a greater likelihood of approval. In this fashion, piecemeal variance from certain standards are allowed to spread "ripple effect" throughout a given area of the District. The result is a cumulative loss to the integrity and historic character of the District.

4. MANAGEMENT RECOMMENDATIONS

Figures 15a and 15b depict the principal land use/opportunities and constraints for the APC.

4.1 Policy Framework

Establishing a comprehensive policy framework to guide decision-making for improvements and future development of the St. Thomas Harbor and Waterfront APC is a crucial and fundamental process to be undertaken if the problems of similar ports and urban waterfronts elsewhere are to be avoided. Private citizens, elected leaders, citizen action groups, other community groups, and the business community must all participate in the planning and goal-setting process, and reach consensus on the best strategy to pursue to ensure that the St. Thomas Harbor and Waterfront APC develops with vitality and sound planning, and in a way that does not lose sight of its maritime heritage and continuing economic importance as a regionally competitive port.

One avenue to pursue in this regard is the development of a comprehensive "Harbor and Waterfront Revitalization Plan". In such a plan, multiple goals must be simultaneously explored, and specific implementation strategies adopted (addressing the issues of funding and leadership), if concerted action is to prevail.

It has been almost twelve years since an original management plan for this APC was drafted. Many of the recommendations contained in that report remain valid today. Unfortunately, the costs to carry out many of those recommendations have increased by several orders of magnitude.

The first concern should be to assess the need to establish an appropriate body to tackle the unique problems of the St. Thomas Harbor and Waterfront. A Waterfront Revitalization Commission that brings together government agencies, the business community and residents to formulate plans, raise funds through the government and community, and finally ensure implementation of plans.

Without such a local body, the prospects would not seem good for coordination of the multi-sectoral planning issues that must be addressed in a "Harbor and Waterfront Revitalization Plan". Community organizing is simply too time-consuming and process-oriented to be undertaken as an added responsibility of an existing agency whose focus is the entire Territory. And without the necessary community support for the expenditure of public funds, there likely never will be any public funds, because the necessary bond measures or tax levies will most likely not be legislated or brought to vote by general referendum.

1A *The community should examine the merits of establishing the appropriate body to deal with the many, complex problems of a growing, dynamic working port and urban environment. A Harbor and Waterfront Revitalization Commission should be considered as one alternative to launch the type of community-based planning effort, one involving the business community, needed to make a Harbor and Waterfront Revitalization Plan for St. Thomas Harbor a reality.*

The St. Thomas Harbor and Waterfront should continue to serve the local community, both residents and visitors alike, by providing the facilities and services for water-dependent industry and navigation, and by providing ample opportunities for recreation and enjoyment of the unique cultural, historical, and scenic qualities of this regional port, while sustaining clean waters and healthy fish and wildlife habitat, and ameliorating coastal hazards wherever they exist.

Specific goals in support of the foregoing include focus on the following list of opportunities in the revitalization effort:

- 3,4 1. *improved public access, both visual and physical, to the waterfront and all its amenities, and expand on the area inland which can enjoy waterfront benefits (i.e., through strict controls on building height and orientation);*
2. *enhanced economic activity in a sustainable manner and which provides the appropriate level of services and facilities to residents and visitors alike; achieve an appropriate mixed-use of land resources that allows for the optimum use of land with minimum reliance on automobile transportation;*
- 13 3. *preservation of the historic and cultural character of Charlotte Amalie, to the maximum extent possible;*
- 1A 4. *enhanced public safety through rehabilitation of dilapidated portions of the waterfront, and through improvements to transportation and pedestrian systems*

- that will allow the more efficient (i.e., decreased costs and time) and safe movement of goods and people on both land and water;*
5. *reduced potential loss of life and property due to natural hazards through a combination of growth management policy and maintenance of existing shoreline protection structures;*
 6. *improved water quality within St. Thomas Harbor and the maintenance of remaining aquatic and wildlife habitat;*
 7. *injection of new life and energy into the port and downtown area, recognizing that it is the combination of waterfront activities and the unique character of Charlotte Amalie that attract residents and visitors, and which represents great potential for simultaneous recreational enjoyment and achievement of governmental, business, trade, commerce, and industry needs;*
 8. *improved efficiencies in the various port operations, including the development of management plans to deal with the transportation, storage, and handling of hazardous and toxic cargo, and the development of spill management plans with trained personnel and proper equipment ready for response at all times.*

Given that waterfront planning should **not** work in isolation of the nearby urban center, public access policy should strive to allow the benefits derived from the waterfront (i.e., scenic vistas, open space, fresh air, general human interest) to be enjoyed as far inland as possible.

- 3 This suggests that future developments should be oriented perpendicularly rather than parallel to the shoreline to enhance view corridors to the sea, and that stricter height and space limitations be placed on buildings closer to the waterfront. Successful urban waterfront areas generally have plenty of open space, or "green" space, to accomplish this goal. Both physical and visual access to the shoreline must always be considered.

3/4 The St. Thomas waterfront has several opportunities for improvement in this regard. For many tourists, Charlotte Amalie and the harbor are the only areas they are able to enjoy during their short one-day visit as cruise ship passengers. Many of these downtown visitors are pedestrians for most of their stay, and would be attracted to facilities which cater to pedestrian needs, for example:

1. shaded rest stops with benches and awnings;
2. tree-lined walkways;
3. restroom facilities
4. appropriate night lighting;
5. scenic vista points and/or "interest" points with interpretive signs of the area's natural and cultural heritage; and
6. a public information center.

Much discussion has ensued over the past several years concerning the construction of a waterfront boardwalk or "promenade", or of converting Main Street into an open pedestrian

mall. This Comprehensive Analytic Study and proposed Management Plan support these ideas conceptually as elements worthy of additional planning and public discussion.

4/ ✓ *The goal is to make downtown Charlotte Amalie and its waterfront "user friendly", safe, and an enjoyable learning experience for those who wish to take advantage of all the area has to offer. Minimally, improvements to the existing shoreline walkway should be carried out, with its continuation west along the shoreline past Frenchtown and to Crown Bay if possible. The old pumphouse at Frederiksberg Point should be removed, and the area turned into an attractive rest spot and scenic viewpoint for pedestrians. This will need to be assessed in concert with the possible need to widen Veteran's Drive around Frederiksberg Point to relieve the present traffic bottleneck.*

4/ Recreational opportunities normally associated with a shoreside park (e.g., open, landscaped space with plenty of shaded benches and playground equipment for children) should be expanded and improved at Long Bay and elsewhere, with special regard to the various user groups (i.e., handicapped, senior citizens, youth, toddlers, etc.). The tennis courts are being renovated and construction of a public swimming pool should be considered.

Other existing recreational facilities need proper funding and management oversight to ensure they remain safe, functional, and accessible to all segments of society. These include, as a minimum, the Joseph Aubain softball field in Frenchtown, the Emile Griffith ball park, the Sub Base and Buddhøw tennis courts, the Pearson Gardens recreation center, and Emancipation Park.

4/ 1/3 Additional waterfront recreational opportunities can be found at Hassel Island and Water Island. Currently, there is only limited access to Hassel Island, and the safe and efficient movement of visitors needs to be planned and developed. Hassel Island should be allowed to remain in its low-intensity developmental state. The maintenance of open space for cultural and recreational activities, the development of recreational opportunities, and further efforts to preserve historic resources should be formally established as general policy goals for Hassel Island. The old Creque Boatyard on the island's north shore would be an ideal site for construction of a maritime history museum.

Overall, there is a need to clearly define the island's management and resource use goal, and to develop a tourism policy and supporting infrastructure that is compatible with the scenic qualities of the island. It is often said that the scenic integrity of Hassel Island determines in large part the character of Charlotte Amalie.

The situation for Water Island is similar, in that policy goals should be developed with clear definition of acceptable and non-acceptable land and water uses. A general low-density land and water use goal should be adopted, with increased attention to the growing demand for safe small boat anchorages removed from navigational conflict in West Gregerie Channel. If

4 developed properly, Water Island and Hassel Island could become attractive destinations for visitors and residents alike.

In all scenarios for management of the APC, improved transportation networks -- both on land and on water -- must become a central goal. The current congestion and lack of parking in the downtown area is perhaps its greatest drawback. Solutions to transportation problems will undoubtedly be controversial, as every alternative explored will involve a displacement or reduction in at least one constituency's livelihood. But transportation solutions should be viewed as much more than economic choice. Improved transportation efficiencies are central to society's health, safety, and welfare.

For this reason, planners must begin to see the problem of urban transportation congestion as an island-wide, land use planning and (public) economic choice issue. The island's land use patterns define its transport system more than any traffic engineer or planner possibly can. This is true as well for the downtown area.

Charlotte Amalie's transport system will function better if, in the long term, "things are closer to home", and those who work in the downtown area also reside and receive essential services close by. This type of land use, whereby homes are integrated with workplaces and other amenities, is in fact closer to the traditional land use pattern for Charlotte Amalie, prior to the initiation of low-intensity, sprawl-type development extending in uncoordinated fashion throughout the island during the past three or four decades.

The essential point is that the pattern of urban growth and land use dictates whether people can walk or cycle to work, or whether they need to travel a dozen kilometers or more by automobile to get to work and back home. "By failing to see land use planning as a transportation strategy, many of the world's cities have allowed the automobile to shape them" (Lowe, 1992).

1A In this regard, this Study for the St. Thomas Harbor and Waterfront APC supports the preferred "Town Centers" alternative proposed in the draft Comprehensive Land and Water Use Plan (DPNR/CCZP). That study of prevailing land use patterns and projected growth demands for St. Thomas has identified several key concepts in physical and environmental planning that should be adopted quickly as policy and law. The following is an excerpt from the draft Comprehensive Land and Water Use Plan:

Charlotte Amalie would continue to be the primary urban center on the island. Urban growth and development is envisioned to expand under this scenario eastward toward Donoe, as well as into the Contant and Lindbergh Bay areas to the west. The growth that occurs in Charlotte Amalie should take the form of increased amounts of mixed use development. Mixed use, within an urban context, refers to one building having a

number of different, but compatible, activities under one roof (for example, shops on the first floor and housing located above it).

Within the context of any expansion or redevelopment of Charlotte Amalie, care must be taken to preserve the integrity of the historic structures. This community contains many buildings that date back to the island's colonial past. Some have been carefully restored to their original state, and others have been changed from their original use with sensitivity so that the architectural integrity has been maintained.

The Town Centers alternative would be the most efficient in terms of using existing infrastructure (water, sewer, roads) to accommodate future development. Allocating more land for higher intensity urban activities and locating these areas where the roadways and other services already exist will be most cost-effective. Additionally, a strong neighborhood focus, or "sense of place", would be reinforced on the island and residents would continue to identify with their own particular geographic area (Strategic Planning Group, 1991).

Nevertheless and despite the need for long-term (advanced) planning as described above, immediate, short-term improvements to the downtown area's transportation problems are possible given the will to carry them out. Water taxis, ferries, or other such supplemental transportation should be assessed as a means to alleviate land-based traffic congestion. Park-and-ride programs involving both land and water transportation could be implemented with minimal capital investment. They would of course require political will and leadership to establish the appropriate incentives necessary for the private sector to develop new transportation services or reorganize existing ones. Such change will take time, but is essential if further congestion and eventual stagnation are to be avoided.

This approach, known as Transportation Systems Management (TSM), explores the alternatives to construction, including public transportation improvements and traffic management techniques such as designated turning lanes, spot mitigation of bottlenecks, and parking improvements, before large-scale highway development is undertaken. The Department of Public Works presently has an active program of traffic analysis and engineering, and should be supported in their efforts. Among the many improvements, the public transportation system, VITRAN, has increased ridership by four-fold since its start-up in 1990 (pers. comm., R. Richardson, DPW).

But there still exist bottlenecks that must be dealt with, the most pressing one being the two-lane stretch of road around Frederiksberg Point just west of Long Bay. Although this Study and Proposed Management Plan call for the preservation of the existing waterfront character wherever possible, this is one stretch that may require widening, which would necessitate limited fill of shoreline to accommodate the road expansion. If this is objectionable, other alternatives should be explored and reassessed, including the previously identified options of a

one-way street system to circumvent the bottleneck (Figure 16) and/or a major bypass road constructed along the ridges above Charlotte Amalie.

- 17 The policy framework for St. Thomas Harbor must also address the issue of navigational safety and congestion within the harbor. In 1987, the U.S. Coast Guard submitted to the Governor several alternatives for marine traffic and anchorage management for the Harbor. The alternatives were derived based on consultation with the Port Authority and DPNR officials. The preferred option was to prohibit the anchorage of large vessels (greater than 150 feet) in the inner harbor, which would require all cruise ships (except for those docking at the WICO and Crown Bay docks) to anchor in the outer harbor. The intent of the plan was to alleviate congestion, increase navigational safety, and to allow for safer sea plane take-offs and landings. The plan has been endorsed by several agencies, and was finally submitted (January 1993) by the V.I. Government to the USCG with a request to pursue the federal law amendments needed to effect the plan (letter dated 29 January 1993 from Governor A. Farrelly to Mr. G. Marsh, Captain, USCG).
- 18 The Anchorage Management Plan for St. Thomas Harbor should be cognizant of the need to increase not only navigational safety, but the efficiencies involved in transporting people and goods throughout the Harbor. The Plan should address the need to identify and develop specific land/water "nodal" points, where the movement of people and goods from land to water can occur with minimal disruption of other activities, and with plenty of space to render such operations safe and efficient. The concept of a "gateway", where cruise ship passengers can arrive at shore by launch to an area with plenty of space where desired amenities and services are provided, should be seriously examined.

Finally, environmental monitoring and enforcement (recognized here as separate functions) for the Territory, and for the St. Thomas Harbor and Waterfront area in particular, would perhaps benefit from a review of available governmental resources (human, financial, and equipment). Virtually every division within DPNR that is involved in environmental monitoring or enforcement must presently operate with only a limited number of vehicles, vessels, or other equipment to carry out its function. In many cases, an operations and maintenance program (including the necessary provision of spare parts) for equipment, vessels, and vehicles, if properly funded, would assist to ensure that monitoring and enforcement needs are met in a timely manner. Moreover, environmental monitoring and enforcement should be seen as growing needs, and as such the Government (DPNR) might want to examine the feasibility and desirability of privatizing certain aspects of environmental monitoring and enforcement. This is a growing trend in communities throughout the United States.

4.2 Planning and Permitting

The St. Thomas Waterfront APC is currently comprised of at least eleven (11) different zoning designations (Figures 17a-d). From Frenchman's Reef to Havensight, areas within the

APC are zoned R-1 (residential low density), R-3 (residential medium density), C (commercial), and W-2 (waterfront commercial-industrial). From Long Bay to Downtown Waterfront, current zoning consists solely of W-1 (waterfront-pleasure), although B-1 (central business district) and P (public) adjoin the APC boundary immediately across Veteran's Drive. In Frenchtown and Vicinity, lands are zoned R-3 (residential medium density), R-4 (residential medium density), P (public), W-1 (waterfront-pleasure), and W-2 (waterfront commercial-industrial). Crown Bay and Krum Bay are zoned largely W-2 (waterfront commercial-industrial) and I-2 (industry light), with public land indicated for a portion of the hill extending inland from Regis Point. Hassel Island is zoned W-1 (waterfront-pleasure) in its entirety, as is the western half of Water Island; its eastern half is zoned R-1 (residential low density). Permitted uses for these zones can be found in the V.I. Code, Title 29, Chapter 3, Section 228.

In the early 1980's, DPNR/CZMP prepared and adopted the Coastal Land and Water Use Plan (CLWUP), which designates all coastal areas of the Territory as one of ten (10) classifications. The CLWUP designations were, in some locations in the Territory, in conflict with the existing zoning designations. For the St. Thomas Harbor and Waterfront APC, however, the CLWUP basically supported the earlier zoning designations, and provided new refinement of allowable water uses.

Since the late 1980s, DPNR/Comprehensive Planning staff have worked to prepare a Comprehensive Land and Water Use Plan that will re-designate all land and water in the Territory as one of ten (10) new designations, known as "Intensity Districts". The goal of the Comprehensive Plans is to ensure that the quality of life for island residents is maximized.

Natural Hazards Mitigation

- 6 There is a need in the Territory for an effective coastal storm hazard mitigation policy and plan. The siting of facilities along the coast increases the threat of three types of coastal storm impacts: (1) threats to public health, safety, and welfare; (2) costs to tax payers for disaster relief and protection; and (3) losses of irreplaceable natural resources (Godschalk, *et al.*, 1989). Compounding the potential for catastrophic losses due to coastal storms is the possibility of significant sea level rise (SLR) in the decades ahead.

While average SLR over the last century has been less than one-foot (10-15 cm), an increase in that much or more (10-20 cm) is projected by 2025, and of between 1.5 and 6.5 feet (50-200 cm) by the year 2100. Using an average of 1 meter (3.3 ft) of shoreline erosion per cm of SLR, the resulting average by 2025 would be 33 to 66 feet (10-20 meters) [Godschalk, *et al.*, 1989].

There are generally three strategies that may be adopted to mitigate coastal storm hazards and SLR impacts. First, the natural coastline can be "hardened" by using designed protective

structures, such as bulkheads, revetments, gabions, etc.. Second, facilities and structures built in high hazard areas can also be hardened through the use of stricter building standards to achieve increased wind and/or flooding resistance. These strategies often require resorting to and preparing for evacuation of people during a storm event, with its incumbent risk to human life.

- 5 Third, and a better approach, coastal development can be redirected away from high hazard areas through the use of shoreline setback standards and/or re-zoning of high hazard areas to achieve simultaneous risk reduction and other objectives such as open space preservation or wildlife management.

This "development management" strategy, is generally the most cost-effective option. As with the use of stricter building codes, increased costs associated with the alteration of land use patterns to reduce the exposure of people and property to storm damage are generally offset by long-term savings (from less damage) and reduced insurance rates. It is always (politically) easier to add a hazard mitigation section to an existing plan, regulation, or program than it is to adopt a totally new set of tools. In fact, there is no better time than today to prepare for the next storm, by introducing legislation that will require the use of new guidelines for decision-making during the next re-building effort.

- 5 *A coastal storm hazard mitigation policy and regulations should be developed for the Territory, and for the St. Thomas Harbor and Waterfront on a site-specific basis. A "development management" alternative to hazard mitigation is recommended, and will require that implementing legislation be enacted soon in preparation for the next disaster. Suggested recommendations are:*

**direct future public and private developments away from high hazard areas;*

**for existing development, consider policies and regulations that can be implemented now to minimize losses during the next storm; and*

**establish now (i.e., prior to its need) a plan to guide reconstruction following the next storm so that design and siting mistakes are not repeated.*

Proposed developments within the designated Coastal Barrier Resources System should be required to pass a strict "public need" criteria test, and approved only if no alternative site for the same use can be found.

As seen above (section 2.3.2), earthquake potential in the Territory is high. Slopes on lands adjacent to the APC boundary are considerable, while a large part of coastal development in this APC sits on filled land.

5 *Appropriate attention should be paid in the design of major facilities, especially those which will house large assemblies of people, so that threats from seismic activity are absolutely minimized.*

Although the liquefaction potential of landfill soils has not been determined for any filled lands in the Territory, logic suggests that certain compaction standards be adhered to and a certified engineer's report required for all major facilities.

5 *Within the APC watershed, seismic hazards should be incorporated into subdivision regulations, with strict controls on development in high hazard areas.*

Flooding mitigation will be an ongoing concern for new developments in many locations in the APC and its watersheds. As mentioned above (section 2.3.3), A-Zone floodplain exist throughout the area, and two areas on Water Island are designated sites in the Coastal Barrier Resources System.

14 *Strict adherence to National Flood Insurance Program (NFIP) policies and regulations is recommended, and new developments restricted where the hydrology and flooding potential of an area may adversely affect important wildlife habitat or other natural features. Channelization for flood control should be avoided wherever possible, and new developments directed away from floodplain hazard areas.*

6 *Cumulative impacts from the increased use of non-porous surface materials should be assessed, and guidelines established for the use of "grassphalt" and other porous surface materials on access roads, parking lots, and other suitable areas.*

6 *In addition to the above efforts for flood mitigation, a stormwater management plan should be developed and adopted for the APC and its watersheds. Regular maintenance of drainage systems, and an assessment of proper culvert sizing should be given priority (see also nonpoint source controls below).*

Water

One of the most significant coastal water quality concerns in the APC is that of chronic turbidity due to propeller wash of bottom sediments and stormwater runoff.

11 Recommendations for stormwater runoff are given below, but in the case of propeller wash, mitigation strategies are limited. Given that much of the marine benthic environment in Krum Bay and the inner St. Thomas Harbor is already degraded and that the area is highly dependent on its marine transportation network, perhaps this is a classical trade-off. Where warranted, however, small-scale, site-specific mitigation of sedimentation effects can be accomplished through the use of siltation curtains, weirs, cascaded settling ponds, and improved dredging practices. Such mitigation techniques should be routinely used during 10 dredge and fill operations. Dredging can result in resuspension of fines and contaminant-

laden sediments, with significant adverse impacts on coral reefs, seagrass beds, and other benthic communities. However, routine maintenance dredging (utilizing siltation curtains) at key locations in the harbor could serve to maintain sufficient depths to minimize chronic turbidity effects from propeller wash.

Coastal water quality is adversely affected by oil spills and the potential for a major oil spill is relatively high for the St. Thomas Harbor. Oil spill contingency plans are under preparation by both the V.I. Government (DPNR/DEP) and the U.S. Coast Guard. The DPNR/DEP currently awaits USEPA approval on a draft oil spill contingency plan. The USCG plan, which will be developed in coordination with the relevant federal and local agencies, will be a revision of an earlier plan (Oil and Hazardous Materials Response Plan for Puerto Rico and the U.S. Virgin Islands), and has a July 1993 scheduled completion date as stipulated under the Oil Pollution Act (OPA) of 1990 and its regulations.

Under the new OPA regulations, vessels and facilities that handle any kind of oil are required to demonstrate that response capability exists. Personnel training, equipment, and exercise drills are required components. As such, the private sector is in large part joining forces to support the development of "cooperatives" that will provide the required "on-call" oil spill response capability. One of these cooperatives, the Marine Spill Response Corporation (MSRC) will have facilities, including a 210' vessel, located at the Hess Oil Corporation Refinery on St. Croix.

Government facilities (including the WAPA power plant at Krum Bay) must in the near future also meet the requirement to develop a site-specific oil and hazardous material spill response plan.

Marina fueling and boat repair services in the APC must be designed, maintained, and operated to reduce the risk of accidental spill and to facilitate clean-up in the event of a spill. Design practices include as a minimum:

1. *design boat hull maintenance areas to minimize contaminant-laden runoff;*
2. *locate and design fueling station and maintenance areas so that spills can be contained in a limited area;*
3. *implement source control practices such as vacuuming of impervious areas; use of tarpaulins to collect paint chips, sandings, and paint drippings; and use of sanders with vacuum attachments to collect hull paint sandings;*
4. *design spill contingency plans; and*
5. *design areas to include appropriate spill containment equipment.*

Liquid materials like oil, solvents, antifreeze, paints, etc., should be prevented from entering coastal waters within the APC. Also, appropriate storage, transfer, containment, and disposal

facilities should be provided and maintained, and recycling of liquid materials (especially oil) should be encouraged. Possible practices to implement these goals include as a minimum:

1. *build curbs, berms, or other spill containment barriers around areas used for liquid material storage. Store liquid materials in areas that are impervious to those materials;*
2. *separate containers for disposal of waste oil, waste gasoline, used antifreeze, and oil-contaminated water; diesel, kerosene, and mineral spirits containers should be clearly labeled;*
3. *marina patrons and employees should be directed as to proper disposal methods for these materials through signs, mailings, training, etc.*

The amount of fuel and oil from boat bilges and fuel tank air vents entering marina and coastal waters should be minimized. Practices to implement this goal include as a minimum:

1. *use the best available technology (BAT) on air vents or tank stems of fuel tanks to prevent fuel from overflowing through tank air vents and spilling into coastal waters; and*
2. *place oil-absorbing materials in bilge areas of all boats with inboard engines; check these once a year and replace as necessary; recycle, if possible, or dispose of properly.*

Additional management measures for the control of pollution associated with marinas may be found in the (draft) 1993 Nonpoint Source Management Measures, co-produced by the USEPA and NOAA (available at DPNR/CZMP).

Nonpoint source pollution is a significant contributor to the overall degradation of nearshore environments in the U.S. Virgin Islands (Tetra Tech, 1991b). Although the islands have no perennial streams or rivers, episodic events of intense rainfall deliver pulses of fresh water laden with sediments, nutrients, organic matter, and potentially toxic chemicals to nearshore receiving waters. Control of nonpoint source pollution may have significant positive effects on coastal marine habitats. DPNR/CZMP has recently (1992) initiated a nonpoint source pollution control program funded under §319 of the federal Clean Water Act.

The following list of recommendations for nonpoint source discharge control is adapted from Tetra Tech, Inc. (1991b):

1. *separate storm and sanitary sewers;*
2. *repair sewer lines to prevent sewage from being carried via stormwater runoff into the harbor;*

3. *regulate land use practices and behaviors that contaminate stormwater (e.g., improper waste oil disposal, improper use of pesticides and herbicides, discharge of laundromat effluent and dry cleaning fluids into guts);*
4. *impose routine inspection and management requirements for on-site (septic tank) wastewater systems;*
5. *develop treatment options for stormwater (e.g., detention basins, grassy swales, vegetation buffers, artificial wetlands);*
6. *implement source control practices such as street sweeping;*
7. *implement soil conservation measures on all construction projects (e.g., vegetation buffer zones, retention basins, silt-curtains, diversion ditches, etc.); and*
8. *establish performance standards to reduce the total area of non-porous surface materials used on access roads, driveways, and parking areas; encourage the use of permeable materials such as "grassphalt", gravel, or appropriate vegetation.*

A priority should be to maintain and repair sewer lines so that sewage does not leak or is not discharged into the harbor. Ambient water quality data collected by DPNR/DEP has for several years indicated several significant sewage (fecal coliform) sources, both land-based and throughout the APC waterfront (Wernicke and Towle, 1983). As indicated previously (section 3.3.1), there are at least a half dozen sites in the APC where sewage contaminated water enters the harbor.

All sewage contamination points should be identified and immediate steps correct deficiencies in the sewer system. In addition, the contribution of septic tank effluents or, in some cases the complete lack of on-site wastewater facilities, needs to be systematically examined and assessed by DPNR and the Department of Health.

Proper attention must be paid to the operation and maintenance (O&M) procedures of municipal wastewater treatment facilities, not only to ensure that discharged effluent meets TPDES requirements, but that the collection system is leak-proof and of sufficient capacity to handle peak flows. Three of the worst areas that require immediate attention are:

1. the outfall in front of the Federal Building;
2. East Gregory Channel where hillside homes are connected to a sewage line that empties directly into the channel; and
3. the alley west of the Emancipation Garden Post Office.

To achieve this goal, the Department of Public Works should:

1. *establish timeframes for corrective action based on problems addressed in its currently ongoing evaluation of the capabilities of the sewage treatment plant and its collection system to sustain compliance with TPDES requirements;*
2. *develop a continuing program to promote efficient operations, maintenance, and replacement of equipment; and*
3. *anticipate future needs for planning, design, and construction of facilities required to replace, upgrade, or expand existing facilities to maintain compliance.*

Specific short-term objectives shall include:

1. *give high priority to an inspection program for the sewer collection system in the Charlotte Amalie area;*
2. *repair leaks and/or upgrade with new pipes where needed;*
3. *discontinue the practice of dumping chlorine into stormwater drainage channels (as odor control);*
4. *establish an inspection program for all on-site sewage treatment systems (septic tanks).*

Another contaminant found in storm drains is waste oil. Several stormwater channels in the Harbor area have become the public's dumping grounds for waste oil. The worst of these can be found at the drainage channel which terminates at the Frenchtown Fish Market. There are currently very few places for the public to dispose of waste oil in the Territory, so it is often illegally disposed of on the land or in the sea (rather than kept in sealed containers as is the official interim guideline).

The strictest enforcement actions and penalties should be instituted for persons caught illegally disposing of waste oil. Such actions should be undertaken in concert with a public awareness program on the environmental effects of improperly disposed oil.

7 A well-designed and targeted Water Quality Monitoring (WQM) program is essential if territorial Water Quality Standards are to be met, and if specific management actions are to be undertaken in response to degraded water quality. Although DPNR has been monitoring water quality for over fifteen years, the data collected is largely not used to make management decisions. This is in part due to the lack of an Action Plan in the event that violations of Water Quality Standards occur (USVI Govt/DPNR, 1989).

Moreover, routine monitoring of the living (biological) resources in the Territory's coastal waters is not performed (e.g., submerged aquatic vegetation, benthic invertebrate communities, corals, mangroves, etc.) [USVI Govt/DPNR, 1992b]. Biological monitoring can provide valuable information on the health of the environment, and should be incorporated

into an improved WQM program with adequate funding and achievable goals for targeted areas.

In the last quarter of 1992, DPNR/DEP curtailed WQM on St. Thomas and St. John because DEP incurred an administrative problem leaving it unable to fund the sample analyses and DEP was unable to secure the use of a vessel to perform the field work at that time.

- 7 *The Water Quality Monitoring program should assess its priorities (by a public/private sector or interagency task force). A strong goal-oriented water quality monitoring program is of fundamental importance and the advantages of privatization of this function should be assessed. DEP needs to formalize an agreement with DEE regarding the use of a vessel for the scheduled quarterly sampling and for any other special time sampling might be needed. This would be far more cost-effective for DEP than operating its own vessel as it does on St. Croix.*

In addition, the WQM program needs to be able to sample sites during adverse weather conditions to be able to record the water conditions at the time of receipt of the "first flush" of runoff. This will entail the installation of remote sampling equipment near some of the significant gut entrances (to the harbor). Setup and maintenance of the equipment could be coordinated with UVI, for example.

For several years the growing (and cumulative) problem of vessel waste discharges to the marine environment has been recognized. With stimulus and funding from the USEPA, in 1983, a Vessel Waste Control Plan (Wernicke and Towle, 1983) was prepared for the Department of Conservation and Cultural Affairs (now, the Department of Planning and Natural Resources). The Plan's three principal recommendations are excerpted here, as they remain valid and significant recommendations today, a decade later:

1. The first step, and the most important, is a clarification of goals. It is impossible to return the coastal embayments (now vessel anchorages and marina sites, etc.) to their original pristine environmental or ecological condition, and it is equally impossible to reduce environmental risks or even pollutant inputs to zero. Stating (or pursuing) unrealistic goals is counter-productive. It encourages both a crisis orientation (short-term fixes to long-term problems) and, worse still, confrontations -- since environmentalists want the whole protective strategy now and Virgin Islands users (residential, commercial, industrial) see no point in taking costly steps toward an unreachable goal.
2. A second step requires the improvement of the scientific basis of DCCA (now DPNR), the Virgin Islands Port Authority, the Department of Public Works, and other V.I. agencies making decisions regarding uses of the environmental

resource base -- involving natural systems which functioned well until intruded upon by the development process and which have limits and carrying capacities of their own, some of which represent resource planning and management uncertainties.

Agencies can, with scientific help, quantify risks. But the scientific basis of agency decisions can be improved without significant increases in costs or delays. Most important of all, the decision making process is rendered more realistic and defensible.

3. The third step involves improved implementation and enforcement of environmental protection strategies. There are limits, however, to DCCA's (DPNR's) monitoring and enforcement responsibilities regarding existing standards for water quality and other environmental indicators. These responsibilities are hampered by personnel limitations, logistic costs, and jurisdictional constraints. Perhaps an alternative exists, even if partial, that would involve the corporate (and government agency) user conscience -- plus the threats of adverse publicity and lawsuits -- to promote and develop widespread compliance with suggested "voluntary" standards. Further, substituting economic incentives, such as a sewage waste discharge tax on vessel discharges or on unacceptable MSD's (Marine Sanitation Devices) -- in certain designated anchorages -- could improve targeted vessel waste enforcement, lower its costs, and generate revenue to pay for the "enforcement" activity.

1,8 The vessel waste problem should be seen as the Territory-wide issue that it is. Priority issues need to be identified based on current information available (which suggests a targeted update of IRF's 1983 study), and by involving the boating industry in true partnership fashion to achieve a specific work plan. The commercial ferry boat companies, which transport large numbers of passengers in the Virgin Islands on a daily basis, should be included in the development of a vessel waste control action plan. In other words, the solution is for the Government to lead on this growing and fundamental problem by requiring that the service marinas provide shoreside pump-out facilities and that the commercial boating industry, resident and visiting yachts comply with MSD requirements and use these facilities.

Industrial Wastewater

✓ Marine biological communities may be affected by various industrial wastewater discharges within the APC. These discharge points conduct effluent contaminated by toxic or sub-lethal concentrations of organic chemicals and heavy metals. Sub-lethal effects of industrial wastes are not well understood, but mitigation measures should focus on source reduction wherever possible. Although the limited industrial activity within the APC is generally confined to the

Krum Bay area, efforts should be made to promote changes in industrial processes and encourage recycling of industrial wastes wherever possible.

Thermal effluents from power plants and other industrial processes can result in adverse impacts to biological communities in the effluent receiving waters. These communities may be adversely affected by temperature changes from the effluent and by the use of chemicals introduced in the process to reduce biofouling of cooling systems.

The sea water intakes for the Virgin Islands Water and Power Authority's (WAPA) St. Thomas generating and desalination plant are in Krum Bay, however the discharge from this facility is through a tunnel to the west into Lindbergh Bay, outside of this APC, where impacts from the operation of the desalination and power plants (the resultant discharge of warm hypersaline brine and associated chemicals used to reduce biofouling in the cooling systems) are directly felt.

The industrial activity in and around of Krum Bay, and the frequent contamination of bay waters by leaking sewer lines, the discharge of contaminated water from the storm drain at the north end of the bay and direct discharge of bilges and holding tanks from boats moored in the bay adversely affect the water quality at WAPA's seawater intakes.

Solid Waste Management

The international Marine Pollution (MARPOL) treaty requires that member governments provide at least the potential to receive vessel wastes, in accordance with applicable regulations. The Animal And Plant Health Inspection Service (APHIS) of the U.S. Department of Agriculture is the Federal agency responsible for regulating receipt of foreign-sourced solid wastes entering the Territory. Thus, certain food products purchased in the British Virgin Islands, for example, if brought back into the USVI aboard a yacht, are classified as foreign-sourced products, and are subject to USDA inspection and regulation. The USCG works in concert with the USDA to implement MARPOL regulations, and has required the V.I. Government to provide refrigerated containers to receive foreign-sourced solid wastes; these wastes must be shipped to Puerto Rico for processing since the approved processing equipment does not exist in the USVI.

The above requirements will be difficult to meet on a recurrent budgetary basis, and the V.I. Government should explore the possibility of contracting with a private firm to provide such service in accordance with regulations when and if it is needed. The V.I. Government could then demonstrate to the USCG that it has secured the necessary arrangements to provide such service when needed. All expenses should be passed on to the vessel operator who has imported foreign-sourced wastes. Fortunately, most new (large) vessels are now self-contained with respect to liquid and solid wastes, and so the cruise ship industry should generally not require such service in the USVI.

As for municipal solid waste, businesses in the Charlotte Amalie area are required to make their own arrangements to dispose of solid waste, either at the Bovoni landfill themselves or through a contracted service. While it is illegal to dump anything but "litter" into the DPW-provided litter receptacles placed throughout the downtown area (Act 4176, Title 19), commercial solid waste is often dumped in these receptacles nonetheless (pers. comm., G. Patrick, DPW).

Residents in Charlotte Amalie must take their solid waste to the roadside dumpsters, except in a few areas such as portions of Savan where curbside pick-up service is provided by DPW. A problem frequently arises with the latter arrangement in that people use plastic bags (instead of approved garbage bins with covers) to leave trash at curbside, and animals spread the trash before it is picked up (pers. comm., G. Patrick, DPW). Another problem exists with "drive-by dumping", or the indiscriminate tossing of trash bags into bushes from a moving automobile.

Obviously, if the larger problem of inadequate or inconvenient solid waste collection is not resolved, incidental trash will end up as marine debris as it is eventually blown or washed into the Harbor. The solid waste issue will thus require closer look by a dedicated Harbor and Waterfront Revitalization Team.

Resolve to clean up the Territory's shores and to require the responsible parties to clean up Krum Bay and the too-numerous-to-count derelict vessels, remove abandoned vehicles, discarded machinery parts, steel drums, and dilapidated structures in and around that bay is of paramount importance.

Air

Future industrial development proposals, or expansion of existing facilities, should be required to assess the cumulative impact of any new emissions against an established standard, presumably the National Ambient Air Quality Standards (NAAQS). Towards this goal, Government should begin to design and properly staff an ongoing area-wide air quality testing program to determine if NAAQS are being met.

There is a need for more enforcement with respect to the operations of small businesses, such as fiberglass repair shops, dry cleaners, and auto repair and paint shops. The cumulative impact from these diverse sources can be substantial, and perhaps more serious to residents and/or business people in the immediate vicinity of these operations. Large source emissions are dealt with by federal and territorial authorities, while these smaller source emissions are generally left to local authorities for monitoring and enforcement. *DPNR/DEP should assess its technical personnel capacity for monitoring and enforcement of air quality for the growing number of small businesses.*

Noise

Preparers of future environmental assessment reports should be required to assess cumulative noise impacts as they may affect particular target communities within an identifiable radius (or down wind corridor) of the proposed development. The development of a Noise Ordinance for at least portions of the APC may be warranted, but should be driven by the community's felt need for such regulation and Government's ability to effect enforcement.

Biological Resources

Mongoose have thus far not been introduced to Water Island and Hassel Island, and every effort should be made to prohibit their introduction. The same is true for the introduction -- intentional or accidental -- of any other non-native species. A public awareness campaign, especially targeted to the residents of the two islands, should be designed and implemented to ensure that everyone understands the importance of the introduced-species issue, and that domestic pets like cats can be injurious of bird and other animal populations if abandoned.

The southern end of Water Island, known as Flamingo Point, should be left undeveloped. This area more than any other within the APC is of significant biological importance as a known nesting site for the locally endangered Red-billed Tropicbird (*Phaeton aethereus*) and White-tailed Tropicbird (*Phaeton lepturus*).

The frequency of sea turtle injuries from motor boats within the APC has increased in recent years (section 3.3.4).

Increased vigilance by boat operators for marine animals and for other boating traffic, and reduced vessel speeds in the area are called for. Efforts should be undertaken to educate the public of the requirement for vessels to maintain a minimum of 150 feet distance from endangered marine mammals (e.g., the Humpback Whale).

The seagrass beds in Pacquereau Bay are important foraging grounds for Green sea turtles, and should be protected from anchor damage as part of mooring plans. Hawksbill sea turtles are known to forage near Rupert Rocks as well.

Finally, it should be recognized that seabirds are good indicators of the health of an ecosystem. Unexplained deaths of seabirds, like that which happened with pelicans a few years ago near Yacht Haven marina (section 3.3.4), and again during 1992 (*Daily News*, 1992a) should be of concern and cause for immediate attention.

Cultural Resources

The DPNR/DAHP should work to identify the most significant cultural resources worthy of protection within and adjacent to the APC, and establish a priority acquisition list for possible future property acquisition. At the same time, funding mechanisms should be explored to allow for such acquisition. An alternative to acquisition is the encouragement of private sector cooperation in conservation measures, stimulated by the appropriate incentive mechanisms offered by Government.

There are several non-governmental organizations on St. Thomas that would be ideal targets for Government effort to create private/public partnerships for ongoing cultural resource preservation projects. These are: the St. Thomas Historic Trust, the Virgin Islands History Society, and Friends of Denmark, and for historic buildings, the local chapter of the American Institute of Architects. As has occurred elsewhere, particularly in the United States, groups such as these could conceivably be the loci to organize direct community assistance programs for a more proactive strategy of cultural resource conservation. For example, one group might concern itself with salvaging and recycling (historic) construction materials and fittings, to be used elsewhere on renovation or new construction projects. Another group might organize to provide direct labor and/or funding assistance to low-income owners of historic buildings who otherwise are unable to undertake the proper maintenance of the structure. With the longer view in mind, community action will be needed if the Historic District **and its adjacent environs** are to be kept with historic character intact.

As such, the Historic District should not be viewed as having finite boundaries from a planning perspective. The District's adjacent environs are essential as visual buffers and "anchors" -- in style and function -- to preserve the integrity of the District. The waterfront, from the Historic District's western boundary all the way to the Post Office should be planned for and controlled as a "buffer zone" for the Historic District.

Similarly, the Fort Christian area should be seen as an important "focal point" for the Historic District. Unfortunately, the area has been compromised by the use of the Fort for activities not in keeping with the historic character of the area. The fire station, for example, is not the best use of the historic Fort, and its operations are hindered by traffic congestion in the area. Ideally, and realizing that other important factors may necessitate the siting of this station at Fort Christian, fire stations should be located at both ends of the town, given present densities of traffic and people in the town proper.

In the event that cultural sites are to be removed or damaged as a component of a proposed development, mitigation measures should be designed and fully enforced, and should include the requirement for a qualified archaeologist or historian (as appropriate) to direct such mitigation and/or data recovery efforts.

Of paramount concern in the Charlotte Amalie APC are the underwater historic resources of the St. Thomas Harbor, the Harbor entrance, and East Gregory Channel. Given the number of known wrecks, it is unlikely that all of the artifacts from these vessels have been plundered. Efforts must be made to coordinate and develop research efforts, archaeological assessments, and regulations governing submerged resources in Virgin Island waters to ensure their preservation as a valuable historic and cultural resource.

For several years, the DPNR/Division of Archaeology and Historic Preservation (DAHP) has been collecting information to nominate the resources of these areas to the National Register of Historic Places. As a first step, the DAHP commissioned an inventory of recorded shipwrecks in Virgin Islands waters. This inventory currently contains more than 600 entries; however, only a few of these have been located or verified by physical survey and examination.

At this point, a systematic underwater survey has not been conducted of the St. Thomas Harbor APC. Significant underwater resources, including shipwrecks, have not been located, recorded, or evaluated. Before any potentially disturbing activity, including treasure diving and recovery and/or the archaeological excavation of wrecks, is permitted, an initial systematic survey utilizing non-destructive investigative means must be conducted of the underwater resources of the APC. This requirement should be mandatory. Provision for such a survey, conducted by qualified professional underwater archaeologists certified by the Society for Professional Archaeologists (SOPA), will be made with DAHP survey and planning funds or with other grant monies.

Upon completion of the initial survey, resources that appear to be eligible for the National register of Historic Places will be selected for additional testing and for nomination. Once these requirements have been met, the DAHP may consider, on a case-by-case basis, the permitting of scientific archaeological excavation and recording of historic wrecks.

The locations of a few known shipwrecks in the vicinities of Water Island, Hassel Island, and Havensight Point, have been reported to the DAHP. Of immediate concern is a recently reported shipwreck in the area between Rupert's Rock and Havensight Point, where WICO improvements have recently been permitted. In May of 1991, the DAHP found the underwater archaeological survey for this project to be inadequate and requested a more extensive investigation. Subsequently, the presence of an early Eighteenth Century shipwreck in this area has been reported by sport divers. Steps must be taken to insure that plans by WICO or other agencies in this area provide for the adequate recovery or protection of this important resource.

A second area of special concern is the Krum Bay Archaeological District which is listed on the National Register of Historic Places. This unique area contains prehistoric sites which have been dated to about 1500 B.C. Because of its location in an industrial area, the

Archaeological District is constantly threatened by proposed construction, including road improvements.

Finally, both Hassel Island and Water Island contain a wealth of historic and prehistoric cultural resources. The Hassel Island Historic District is listed on the National Register of Historic Places. A major portion of Hassel Island is protected by National Park Service regulations and DAHP review is required of all potential projects which may have an impact on cultural resources. The remainder of Hassel Island which is in private and government ownership, requires careful surveillance to insure that construction and other development activities do not adversely affect the significant cultural resources of Hassel Island. In preparation for land transfer and under its mandates, the National Park Service recently completed an archaeological survey of Water Island and located important cultural resources. It has been recommended that these areas be set aside in preservation.

Further recommendations regarding cultural resources management are found below (sections 4.3 and 4.4).

Transportation

The U.S. Coast Guard's (1987) anchorage management plan for St. Thomas Harbor should be implemented without further delay. DPNR has reportedly forwarded a request to the USCG to begin procedures to amend the Code of Federal Regulations to prohibit the anchoring of vessels greater than 150 feet in the Inner Harbor (pers. comm., D. Barry, DPNR/Comprehensive Planning). But other measures outlined in the 1987 Plan should be implemented at the same time, including the requirement for buoys to mark mooring sites, and the separation of short-term, long-term (transient), and long-term (live aboard) mooring sites to increase the Harbor's navigational efficiency and safety. DPNR should work quickly on these improvements and identify staff and resources necessary to effect enforcement, as the situation will almost certainly worsen if/when sea plane operations resume (as planned) at the sea plane ramp near Frenchtown. Furthermore, it is important to recognize that St. Thomas Harbor can accommodate only so many vessels before hard decisions will need to be reached which restrict further growth in maritime traffic and available moorings.

The relevant agencies should likewise resume planning and discussions on short- and long-term mitigation measures for (land-based) transportation congestion, especially in the Crown Bay area. The present traffic inefficiencies of the area are a poor introduction to the island for disembarking ship passengers at Crown Bay. In addition to the congestion, poor road maintenance adds to the present traffic safety concerns.

As stated previously (section 2.6.1) the Department of Public Works is working to improve the transportation network for the downtown and connecting areas. It is beyond the scope of this planning effort to identify ways to further improve upon their efforts, however, a few

possibilities are worth bearing in mind. A principal issue will be how to improve the bottleneck around Frederiksberg Point. As mentioned earlier (section 4.1), perhaps this is one waterfront stretch where further filling of the Harbor is unavoidable. However, the feasibility should be investigated of re-routing the existing traffic flow, establishing one-way, two-lane traffic in both directions (Figure 16). The alternative is worth closer examination as perhaps a viable alternative to additional filling of the Harbor.

Other measures that should be examined to relieve some of the downtown traffic congestion are:

1. *establish a water taxi or ferry system for the Harbor;*
2. *establish carpooling incentives for the business community and other large groups (i.e. Government employees), with, for example, the use of reserved parking areas for high-occupancy vehicles; and*
3. *rehabilitate Kings Wharf (especially the dock) and adjacent area to allow cruise ship passengers to land by launch, and upgrade pedestrian crossings to the designated taxi stand north of Vendor's Plaza.*

In combination, these improvements could conceivably alleviate some of the present congestion along the waterfront road, and allow for safer pedestrian movement across the road to the commercial district.

Finally, the design of transportation improvements should always seek ways to enhance, rather than impede, physical and visual access to the waterfront. Bus shelters planned for construction along Veteran's Drive in 1993 should be designed with this consideration in mind, and perhaps be constructed with open or glass walls to minimize visual impact.

GEOGRAPHICALLY SPECIFIC RECOMMENDATIONS

FRENCHMANS REEF TO LONG BAY

This area is perhaps the least developed within the APC boundary, and can thus be expected to be the focus of future development pressure. Performance standards which employ Best Management Practices (especially for steep slopes and protection of natural vegetation) should be required of all developments. The area is best suited for low density a mix of residential, commercial (hotel and retail), and recreational developments; the scenic views of the Harbor and Charlotte Amalie are extraordinary from several vantage points along this stretch. As already mentioned, the seagrass beds in Pacquereau Bay need to be protected from anchor damage.

LONG BAY AND DOWNTOWN WATERFRONT

Future development activity west of the Frederiksberg Point and extending to the vicinity of the seaplane shuttle operations should be restricted to maintain this area in its present use. Any shoreline alterations should be minimal. The native fishing boat uses, recreational uses, and traditional waterfront commerce activities should be protected from encroachment by other uses. Any public service facilities for the shoreline, including land transportation, public buildings, utilities, or public recreation, should be designed in a way that the public's physical and visual access to the shoreline is enhanced. Kings Wharf should be renovated to accommodate the smaller launches that arrive from cruise ships anchored offshore, and offloaded passengers directed to utilize the taxi stand north of Vendor's Plaza; crosswalks should be upgraded and maintained for this purpose. In the medium- to long-term, the U.S. Coast Guard should be encouraged to relocate their facilities from Kings Wharf to elsewhere in the harbor, perhaps to the area of the WICO dock in Long Bay. The Kings Wharf area could then be returned to its original use as a public dock/fishing pier. Use of the waterfront apron by vehicles, except for west-bound bus turnouts, should be limited to the movement of cargo only.

FRENCHTOWN AND VICINITY

The waterfront area of Frenchtown and vicinity should be maintained in its present state, with efforts to clean up certain areas. Continued attention should be given to the congestion and safety problems in the marine area, and the issue of public access. A direct sewage discharge into East Gregerie Channel should be eliminated immediately, and the homes and businesses upslope reconnected to the sewer line. DPW is aware of the problem and plans are being prepared to rectify the problem (pers. comm., L.H. Francis, Commissioner, DPW, 1993).

CROWN BAY

The general Crown Bay redevelopment plan by the Port Authority should be implemented, including priority attention to the land-based traffic congestion. The area should be considered as an alternative "Gateway" landing for cruise ship passengers tendered in by launch (an alternative to the Kings Wharf "Gateway", section 4.1). Congestion and navigational safety concerns need to be continually addressed.

KRUM BAY

The Bay's water quality should be routinely monitored and management measures undertaken to ensure that clean water supplies exist for the desalination plant whose uptake lines are located in the middle of the Bay.

The Virgin Islands Government should evaluate and enforce its policy (and the law) on the use of submerged lands. Derelict vessels should be removed regardless of their use. Commercial use of the Bay should not compromise the navigational safety and free use of navigable waters.

The water quality in Krum Bay is seriously compromised by high turbidity levels, reported high levels of fecal coliform, oil contamination, garbage and other debris. Untreated sewage and waste oil (down slope from the DPW maintenance yard, and at other commercial sites within the Bay) is visibly contaminating the bay water.

The sea water intakes for WAPA's generating and desalination plants are located on the west side of Krum Bay, at the southeastern portion of WAPA's property. Any serious pollution incident or boating accident in the Bay could severely compromise the ability of WAPA to supply the island's power and water needs, a situation with profound public health, safety, and economic implications. The large quantities of runoff-borne sand and silt in the water, especially evident following even a brief, heavy rain shower, are resulting in frequent, unscheduled, and costly shut downs to unclog the condensers on WAPA's desalination and turbine units (Francois, 1993). WAPA's desalination units are low-pressure boilers. In this process, the water does not get much hotter than 170°F so certain bacteria are able to survive the "trip" through the system, causing fecal contamination in the distribution side of the water plant, only dealt with by super-chlorination. Additionally, with the continued fecal contamination of the bay tends to allow colonies of bacteria to become resident on the intake (sea water) side of the system. Super-chlorination of the seawater on the intake side of the plant to kill these resident bacteria cannot be done because the high levels of chlorine necessary for disinfection of the intake water result in aggressive corrosion and early failure of the distillation tubes in the water plant.

The Virgin Islands must reconcile its priorities pertaining to the continued use of this bay. If the bay remains to be used heavily by barges and other commercial vessels, and continues to receive contaminated runoff and regular, steady sewage discharges, WAPA will have to extend its seawater intakes to the mouth of the bay, into the well-flushed West Gregerie Channel, to ensure a better quality of intake water. If funding is not found to extend this intake pipe, then measures must be taken to eliminate the adverse impacting agents within the bay and reduce the heavy marine-industrial activities presently ongoing there.

In any case, DPNR/DEP & DEE and the U.S. Coast Guard should respond immediately to these concerns and ensure that WAPA's power and potable water production capability is not compromised in any way.

Krum bay was once known as the "Graveyard of Ships", as damaged ships were routinely disposed of there. It is believed that the hull of a famous arctic exploration vessel lies buried under the WAPA parking lot (Cultural Resource Group, 1988). As noted above (section

2.5.1), three preceramic archaeological sites are designated as the Krum Bay Archaeological District. The sites represent the earliest known human habitation in the northern Virgin Islands. All efforts should be taken to prevent further damage to the known sites within the Archaeological District.

As discussed above, Krum Bay is at a crossroads. The situation should be closely examined and an overall plan for the future of the bay drawn up. This plan should list all current users of the bay, prioritize their importance to the community, determine if their operations require them to be located only in Krum Bay, and assess their impact on the water quality of the bay and other users of the bay. Assuming that there is no plan to relocate WAPA's power generating plant in St. Thomas, WAPA's requirements should be at the top of the list. The goal of the plan should be to allow uses that do not adversely impact on WAPA's operations (increasing WAPA's cost and electricity rates for users), that minimize adverse affects on the water quality of the bay, and that do not impact navigational safety.

HASSEL ISLAND

The present "outdoor museum" character of Hassel Island should be maintained. The island represents a significant educational and cultural experience for residents and visitors alike, and should be developed only with such objectives in mind. Comprehensive planning is essential to ensure that the cultural and natural resources be adequately protected and that the area contributes to the economic and educational welfare of the Territory. Ferry transport services and associated docking and other boating facilities will need to be developed and/or improved, including those at Palm Grove which would make an ideal hiking/campground area.

Meanwhile, several of the island's natural and cultural features are worthy of investments to refurbish and/or improve access and interpretation. These include the Royal Mail Inn, which has great potential as an environmental education center for St. Thomas youth; Creque Boatyard (especially the marine railway and engine house) and facilities at Careening Cove, which would be ideal sites to support the development of a local maritime training program for youth; and the old road/trail along the island's central spine, where numerous historical relics are found and which would make an exceptional experience for the interested ecotourist.

These and other ideas are currently being discussed by the National Park Service, Government officials, and other interested citizens (Koenings, 1992), and will require a broad-based effort if success is to be achieved. In this regard, the Government should invite members of the business community most associated with the tourism industry and encourage their investment and support to accomplish the several improvements needed to develop Hassel Island's full potential as an alternative destination for visitors and residents.

WATER ISLAND

There is a need to develop a preferred land use plan, an economic development plan, and an environmental management plan for Water Island, and incorporate these into the Comprehensive Land and Water Use Plan. The two CBRS sites on Water Island, along with the seabird rookery areas near Flamingo Point, should be established as wildlife sanctuaries.

The transition of ownership and management responsibility for the island to the territorial Government represents a critical planning period, and an opportunity to reverse the trend of neglect that has characterized the past several years of Federal oversight. A cultural resource protection and enhancement plan should be prepared to guide future developments. Furthermore, the V.I. Government should take decisive action to push the Federal Government on its responsibilities to clean up hazardous materials and former weapons storage sites.

4.3 Legislative Change

There is a need for legislative action to consolidate all existing floodplain management regulations under a single Floodplain Development Ordinance. Carried further, such an ordinance should be ideally incorporated into a larger Coastal Growth Management Ordinance, which speaks to the long-term need to control growth and redevelopment in all high hazard areas. Flooding is one of the most significant hazard potentials for the APC, and the likelihood is high of a repeat of flooding similar to that which occurred in the Charlotte Amalie area in 1973 and 1983.

The problem of sewage contamination of storm water because of leaking sewer lines or the discharge of raw sewage through storm drainage culverts as a result of an insufficient capacity of the sewer system should be addressed quickly and decisively. Sewage contamination of stormwater is especially problematical in the St. Thomas Harbor area.

Legislative action is needed to press the owners of derelict vessels to clear out their vessels within a specified time period, or face punitive measures. The Government should demonstrate leadership in this regard, and allocate money to clean up Krum Bay, restoring habitat value to the submerged lands there, rather than allowing the submerged lands to be used (without rent or permit) for commercial operations as is presently the case.

The DPNR/Division of Archaeology and Historic Preservation is currently working on an Antiquities Legislation Bill that will be submitted to the Governor and the Legislature for approval and consideration. This bill will address the requirements for archaeological work anywhere in the Territory.

The Antiquities Legislation Bill will ostensibly bring greater clarification to the question of overlapping jurisdictions on historic protection matters, and will generally strengthen the overall authority and mandate of the Historic Preservation Commission. Coordination on historic preservation matters is important for the APC, if one takes the broader view that the Historic District is, in a practical sense, integral to the overall historic character and visual integrity of the harbor and waterfront.

4.4 Institutional Development

There is also room for increased private/public sector collaboration on several resource management issues. One area that requires considerable institutional development is that of historic preservation. Successful management of the St. Thomas Harbor and Waterfront, including its integral Historic District, will come about quicker and with more lasting results if the local community is drawn into the process. Government should call upon the non-governmental community (the various associations, churches, and other commercial and philanthropic organizations) to address the overall management framework.

The same type of strategy could be applied to the establishment and operation of neighborhood collection centers for toxic and hazardous wastes, including waste oil, and/or for recycling of household solid wastes. In short, community involvement is essential if the fast growing burdens and challenges of growth and waste management are to be effectively met.

A good example of such public/private collaboration is currently underway between the V.I. Government and the V.I. Community Foundation, a non-profit organization that is administering private sector donations to assist a federally funded project to improve sidewalks and landscaping along a row of businesses facing the waterfront. Public/private partnerships are the way of the future, and the federal government, especially the USEPA, is actively encouraging such creative efforts to develop local capacity for self-management on a number of resource issues.

Public/private collaboration could begin to tackle the longstanding issue of enhancing pedestrian amenities. There is only one public restroom in the downtown/waterfront area, and, as has been discussed above, the enhancement of the pedestrian experience (sidewalks, benches, shaded areas, green spaces, landscaping, scenic vista points, interpretive signs, etc.) could pay significant dividends in both visitor and resident enjoyment. Such a project would be well suited for business community involvement, in collaboration with the appropriate combination of government agencies.

5. CONCLUSION

Successful port management in the mid-1990's and beyond will require charismatic leadership and anticipatory planning. Further advances in global communications networks and maritime technologies will require that public port institutions be ever poised to take advantage of new opportunities in maritime trade, ocean exploration, regional fisheries development, communications services, or any of several other presently unforeseeable economic potentials. The successful port will continue to secure its competitive advantage over other ports by analyzing regional and global developments, and by stewarding its primary role -- to provide shore-based facilities for new and expanding uses, always with anticipation of new growth needs.

The United States is presently a world leader in what can be called a "renaissance era" for harbor and waterfront revitalization. Large and small cities, from Boston to San Diego, Charleston to Seattle, have undertaken port revitalization efforts, recognizing that ports are truly "economic development engines", fundamental to a city's or region's economic growth. But, as eminent coastal planner Marc Hershman further points out, a majority of port revitalization efforts have done little to advance "port city" consciousness (Hershman, 1989). Most cities, it seems, have focused instead on creating "people places" out of their urban waterfront, developing "urban recreation zones" comprised almost exclusively of shopping, entertainment, eating, and playing opportunities. Often lost within this new facade is a city's maritime heritage, and an understanding of its relevance to an area's topography, place names, legends, and structures.

This Study and proposed Plan for the St. Thomas Harbor and Waterfront APC is premised on the notion that a balance between urban and port needs is not only achievable, but essential, if this unique economic, natural, and cultural asset of the Virgin Islands is to be preserved and enhanced. The Plan asks for an examination of the need to create a level of local government -- akin to a Harbor Management Division -- whereby needed waterfront revitalization efforts can be comprehensively planned, funded, and coordinated with the many diverse user interests. Most importantly, the Plan hopes to achieve needed dialogue on a vision of what Virgin Islanders would like to see of their primary port in the next 10, 20, and 50 years.

It is important to recognize that the harbor, including Crown and Krum Bays, has extremely poor flushing capacity. Thus, the several existing sources of water pollution must be brought under control if the harbor is to achieve equilibrium in its capacity to assimilate waste inputs. Among the many sources of water pollution identified in this Plan, the following should be given priority attention:

1. Combined Sewage Overflows, resulting in the discharge of raw sewage at several points around the harbor;

2. Untreated stormwater runoff from ill-managed upland watersheds, carrying a variety of nutrient and chemical pollutants to the harbor;
3. Excessive turbidity from natural and man-made causes;
4. Wastewater and solid wastes from vessels; and
5. Waste oil from several sources, most of which could be alleviated with the establishment of a waste oil collection system.

Often not recognized as the environmental and socioeconomic issue that it really is, traffic congestion in the greater Charlotte Amalie area must also be given priority attention. Inadequately studied, air quality within the APC suffers considerably from the present transportation inefficiencies of the area. Moreover, the economic impact associated with literally thousands of lost person-hours each day through traffic tie-ups must not be discounted in the hesitancy of Government and the St. Thomas community to invest in a resolution of this significant problem. These induced inefficiencies cost the community dearly through reduced system productivity and sub-optimal worker performance in every facet of both the public and private sector. In this regard, both short-term and long-term strategies must be employed, including a wider perspective of the role of island-wide land use planning and development control in shaping Charlotte Amalie's future.

REFERENCES CITED

- BC&E/CH₂M Hill, 1979. A sediment reduction program. Prepared for the USVI Government, Department of Conservation and Cultural Affairs. Gainesville, FL.
- Beck, R.W., 1988. Update of power supply evaluations for St. Thomas and long range generation growth plan (exact title not known). Prepared for the Virgin Islands Water and Power Authority. St. Thomas, USVI.
- Bowden, M.J., 1970. Climate, water balance, and climatic change in the northwest Virgin Islands. Published under the auspices of the Caribbean Research Institute, College of the Virgin Islands. St. Thomas, USVI.
- Bowden, M.J., 1974. Hurricanes in paradise: Perception and reality of the hurricane hazard in the Virgin Islands. Published by Island Resources Foundation. St. Thomas, USVI.
- Brill, Peter and Associates, 1991. CZM permit application for: Conceptual master plans for Long Bay Development, Long Bay Marina, Havensight Road Development, Liverpool Estate Development, Rupert Rock Landfill Development, and Rupert Rock Marina. Permit application prepared for West Indian Company Ltd. Anchorage, AK.
- Brower, D.J. and T. Beatley, 1988. Natural hazard mitigation plan for the U.S. Virgin Islands. Prepared for the Virgin Islands Territorial Emergency Management Agency (VITEMA). St. Thomas, USVI.
- Bullen, R.P. and F.W. Sleight, 1963. The Krum Bay site; A preceramic site on St. Thomas, U.S. Virgin Islands. Report No. 5, The W.L. Bryant Foundation.
- CH₂M Hill Southeast, Inc., 1983. Final report: Water management plan for the public water system, U.S. Virgin Islands. Prepared for USVI Government, Department of Conservation and Cultural Affairs, Division of Natural Resources Management. Gainesville, FL.
- Coulbourn, W.C., W.G. Egan, D.A. Olsen and G.B. Heaslip, 1973. yERTS-1 Virgin Islands Experiment 589: Determine boundaries of ERTS and aircraft data within which useful water quality information can be obtained. Grumman Ecosystems Corporation for Goddard Space Flight Center, Greenbelt, MD.
- Cultural Resource Group, 1988. The Historic Resources of the U.S. Virgin Islands. Prepared by the Cultural Resource Group, Caribbean Strategy, National Park Service.

Daily News, 1992a. Dying pelicans. Daily News Publishing Company. 27 November 1992.

Daily News, 1992b. Interior Department offers to sell Water Island land. Daily News Publishing Company. 31 December 1992.

Dalton, Dalton, Newport in association with E.H. McDowell and Associates, 1982.
Supplemental environmental impact statement, Technical appendix B: St. Thomas Harbor water quality study. Prepared for the V.I. Government, Department of Public Works. St. Thomas, USVI.

Dammann, A.E. and D.W. Nellis, 1992. A natural history atlas to the cays of the U.S. Virgin Islands. Pineapple Press. Sarasota, FL.

deJongh and Associates, 1974. Main street mall urban design study. Prepared for the Virgin Islands Planning Office. St. Thomas, USVI.

Federal Emergency Management Agency, 1992a. Flood Insurance Rate Map, U.S. Virgin Islands, Island of St. Thomas. National Flood Insurance Program. Community Panel No. 780000 0010 E; revised August 3, 1992.

Federal Emergency Management Agency, 1992b. Flood Insurance Rate Map, U.S. Virgin Islands, Island of St. Thomas. National Flood Insurance Program. Community Panel No. 780000 0015 E; revised August 3, 1992.

Francois, D., 1993. Letter dated 22 January 1993 from D. Francois, Chief Operating Officer, Water and Power Authority, to J. Harrigan-Farrelly, DPNR/CZMP. St. Thomas, USVI.

Geoscience Associates, 1984a. Phase 1 report; Vulnerability analysis, earthquake hazards of the U.S. Virgin Islands. Prepared for the USVI Government, Office of the Governor, Disaster Programs Office. St. Thomas, USVI.

Geoscience Associates, 1984b. Phase 2 report; Vulnerability analysis, earthquake hazards of the U.S. Virgin Islands. Prepared for the USVI Government, Office of the Governor, Disaster Programs Office. St. Thomas, USVI.

Geraghty and Miller, Inc., 1983. Groundwater management plan for the U.S. Virgin Islands. Prepared for the USVI Government, Department of Conservation and Cultural Affairs. Syosset, NY.

Gjessing, F.C., 1980. Historic resource study of Hassel Island, U.S. Virgin Islands.

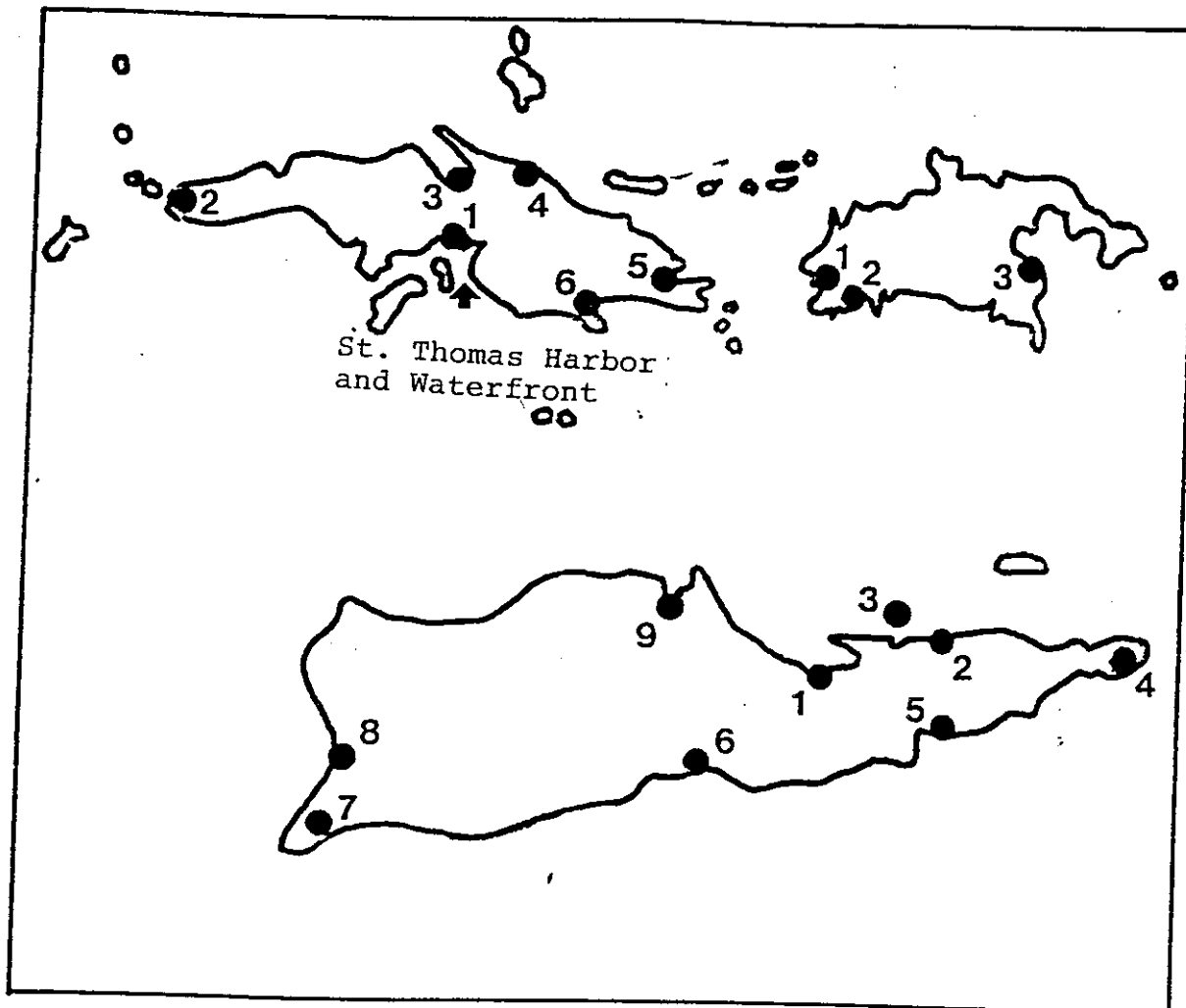
- Godschalk, D.R., D.J. Brower, and T. Beatley, 1989. Catastrophic coastal storms; Hazard mitigation and development management. Duke University Press. Durham, NC.
- Hershman, M.J., 1989. Port concept often adrift in waterfront revitalization. *In Oceanus*, V. 32, No. 3, Fall 1989.
- International Conference of Building Officials, 1988. Uniform Building Code. Whittier, CA.
- Island Resources Foundation, 1977. Marine environments of the Virgin Islands, Technical supplement No.1. Prepared for the USVI Government, Office of the Governor, Virgin Islands Planning Office, Coastal Zone Management Program. St. Thomas, USVI.
- Island Resources Foundation, 1985. Marine archaeology survey of West Indian Co. , LTD., Proposed dredge area long bay, St. Thomas USVI.
- Island Resources Foundation, 1986. Puerto Rico and Virgin Islands coastal barriers summary report. Prepared for the Department of the Interior, U.S. Fish and Wildlife Service. St. Thomas, USVI.
- Jackson, M.D., 1985. The harbor and urban development. *In The St. Thomas Harbor: A Historical Perspective*. The St. Thomas Historical Trust. St. Thomas, USVI.
- Jarvis, J.A., 1944. The Virgin Islands and their people.
- Lowe, M.D., 1992. Shaping cities. *In State of the World: 1992*. Brown, L.R., *et al.*, eds. A WorldWatch Institute Publication. W.W. Norton and Company, New York, NY, USA.
- Marsh, C.E., 1981. A socio-historical analysis of the emancipation of 1848 and the labor revolt of 1878 in the Danish West Indies. Caribbean Research Institute. St. Thomas, USVI.
- McComb Engineering, 1983. Environmental assessment report to the Virgin Islands Coastal Zone Management and U.S. Army Corps of Engineers. Prepared for the West Indian Company, Ltd., for dredging and landfilling of Long Bay, St. Thomas Harbor. St. Thomas, USVI.
- National Park Service, 1983. Virgin Islands National Park: General management plan. U.S. Department of Interior, National Park Service. Southeast Regional Office, Atlanta, GA., USA.
- Nixon, D.W., 1990. The filling of Long Bay: The legacy of a colonial past. *In Ocean and Shoreline Management*, 15 (1990) 1-23.

- Olson, D., 1983. Benthic survey map for St. Thomas Harbor.
- Oostdam, B.L., 1986. Toxic substances in the coastal environment of the U.S. Virgin Islands. In *Transactions of the 12th Caribbean Conference, St. Croix, USVI*, Larue, D.K. and Draper, G., eds. Miami Geological Society. Coral Gables, FL.
- Percious, D.J., R.P. vanEeopoel and D.I. Grigg, 1972. Reconnaissance survey of St. Thomas Harbor and Crown Bay, St. Thomas, U.S. Virgin Islands. Water Pollution Report No. 18; Caribbean Resources Institute, College of the Virgin Islands. St. Thomas, USVI.
- Potter, B., G. Tyson, *et al.*, 1980. Water Island economic development options. Prepared for the V.I. Department of Commerce by the Island Resources Foundation. St. Thomas, USVI.
- Ragster, L.E., 1986. The impacts of development upon the St. Thomas Harbor. In *The St. Thomas Harbor: A Historical Perspective*. The St. Thomas Historical Trust. St. Thomas, USVI.
- Real Estate Data, Inc., 1987. Real estate atlas of the Virgin Islands. Miami, FL.
- Rogers, C., 1990. Responses of coral reefs and reef organisms to sedimentation. *Marine Ecology Progress Series*, Vol.62: 185-202. Inter-Research publications, F.R. Germany.
- Rothgeb, G., 1993. Letter dated 25 January 1993 from G. Rothgeb, Director of Plant Production and Maintenance, Water and Power Authority, to R. Volk, Island Resources Foundation.
- Strategic Planning Group, 1991. U.S. Virgin Islands comprehensive land and water use plan. Prepared for USVI Government, Department of Planning and Natural Resources. Jacksonville, FL.
- Tetra Tech, Inc., 1991a. Identification of data gaps that hinder the determination of the type, degree, and sources of stress to distinctive habitats in Puerto Rico and the U.S. Virgin Islands. Prepared for the U.S. Environmental Protection Agency. Bellevue, WA.
- Tetra Tech, Inc. 1991b. Options to prevent degradation of pristine distinctive habitats in Puerto Rico and the U.S. Virgin Islands. Prepared for the U.S. Environmental Protection Agency. Bellevue, WA.
- Tetra Tech, Inc. 1991c. Distinctive habitats of Puerto Rico and the U.S. Virgin Islands: Determination of the type, degree, and sources of environmental stress. Prepared for the U.S. Environmental Protection Agency. Bellevue, WA.

- Tetra Tech, Inc. 1991d. Distinctive habitats of Puerto Rico and the U.S. Virgin Islands: Characterization, location and areal extent. Prepared for the U.S. Environmental Protection Agency. Bellevue, WA.
- Tetra Tech, Inc. 1992. Draft report characterizing use impairments of the U.S. Virgin Islands and Puerto Rico. Prepared for U.S. Environmental Protection Agency, Marine and Wetlands Protection Branch, Region II. Fairfax, VA.
- Tyson, G.F.Jr., 1986. Socioeconomic history of the St. Thomas Harbor. *In* The St. Thomas Harbor: A Historical Perspective. The St. Thomas Historical Trust. St. Thomas, USVI.
- U.S. Army Corps of Engineers, 1981. Final environmental impact statement: New port facility in Charlotte Amalie, St. Thomas, USVI. Jacksonville, FL.
- U.S. Coast Guard, 1987. Greater Antilles port readiness committee, St. Thomas subcommittee: Charlotte Amalie anchorage management. Report submitted to Governor Alexander A. Farrelly by G.M. Williams, Captain of the Port, Marine Safety Office. San Juan, Puerto Rico.
- U.S. Department of the Interior, 1960. Park and recreation plan for the Virgin Islands.
- U.S. Geological Survey, 1973. Floods in and near the Charlotte Amalie area, St. Thomas, U.S. Virgin Islands. Open File Report, Map Series No. 3. Department of the Interior, U.S. Geological Survey. San Juan, Puerto Rico.
- U.S. Geological Survey, 1982. Central St. Thomas. DMA 1622 IV SW-Series E836. Reston, VA.
- U.S. Geological Survey, 1984a. A workshop on earthquake hazards in the Virgin Islands region. Open-file report 84-762. U.S. Department of the Interior, USGS. Reston, VA.
- U.S. Geological Survey, 1984b. Flood of April 18, 1983 on St. Thomas and St. John, U.S. Virgin Islands. Prepared in Cooperation with the V.I. Public Works Department. USGS, Water Resources Division, Caribbean District. San Juan, Puerto.
- U.S. Geological Survey, 1984c. Estimated water use in St. Thomas, U.S. Virgin Islands; July 1983-June 1984. Prepared in cooperation with the Caribbean Research Institute. USGS, Water Resources Division, Caribbean District. San Juan, Puerto Rico.

- USVI Government, Department of Planning and Natural Resources, 1989. U.S. Virgin Islands Water monitoring strategy; March 1989 - September 1994. USVI Government, Department of Planning and Natural Resources, Division of Environmental Protection. St. Thomas, USVI.
- USVI Government, Department of Planning and Natural Resources, 1991. Areas of particular concern. USVI Government, Department of Planning and Natural Resources, Division of Coastal Zone Management. St. Thomas, USVI.
- USVI Government, Department of Planning and Natural Resources, 1992a. The preliminary assessment of the Virgin Islands of the U.S., Coastal Zone Management Program. Prepared by DPNR/CZMP in fulfillment of Section 309 requirements of the CZMA. St. Thomas, USVI.
- USVI Government, Department of Planning and Natural Resources, 1992b. Water quality assessment: Report 305(b). USVI Government, Department of Planning and Natural Resources, Division of Environmental Protection. St. Croix, USVI.
- Wernicke, W., and E.L. Towle, 1983. Vessel waste control plan for the U.S. Virgin Islands. Prepared for the V.I. Government, Department of Conservation and Cultural Affairs, by the Island Resources Foundation. St. Thomas, USVI.
- Woodbury, R.O. and P.L. Weaver, 1987. The vegetation of St. John and Hassel Island, U.S. Virgin Islands. U.S. Department of the Interior, National Park Service. Atlanta, GA.

AREAS OF PARTICULAR CONCERN



St. Thomas

- 1) St. Thomas Harbor and Waterfront
- 2) Botany Bay (APR)
- 3) Magens Bay and Watershed
- 4) Mandahl Bay (APR)
- 5) Vessup Bay - East End
- 6) Mangrove Lagoon - Benner Bay (APR)

St. John

- 1) Enighed Pond - Cruz Bay
- 2) Chocolate Hole - Great Cruz Bay (APR)
- 3) Coral Bay (APR)

St. Croix

- 1) Christiansted Waterfront
- 2) Southgate Pond - Chenay Bay (APR)
- 3) St. Croix Coral Reef System (APR)
- 4) East End (APR)
- 5) Great Pond and Great Pond Bay (APR)
- 6) Southshore Industrial Area
- 7) Sandy Point
- 8) Frederiksted Waterfront
- 9) Salt River Bay and Watershed (APR)

Figure 1
Regional APC Map
Adapted from: USDOC, 1979

ST. THOMAS HARBOR AND WATERFRONT (East)

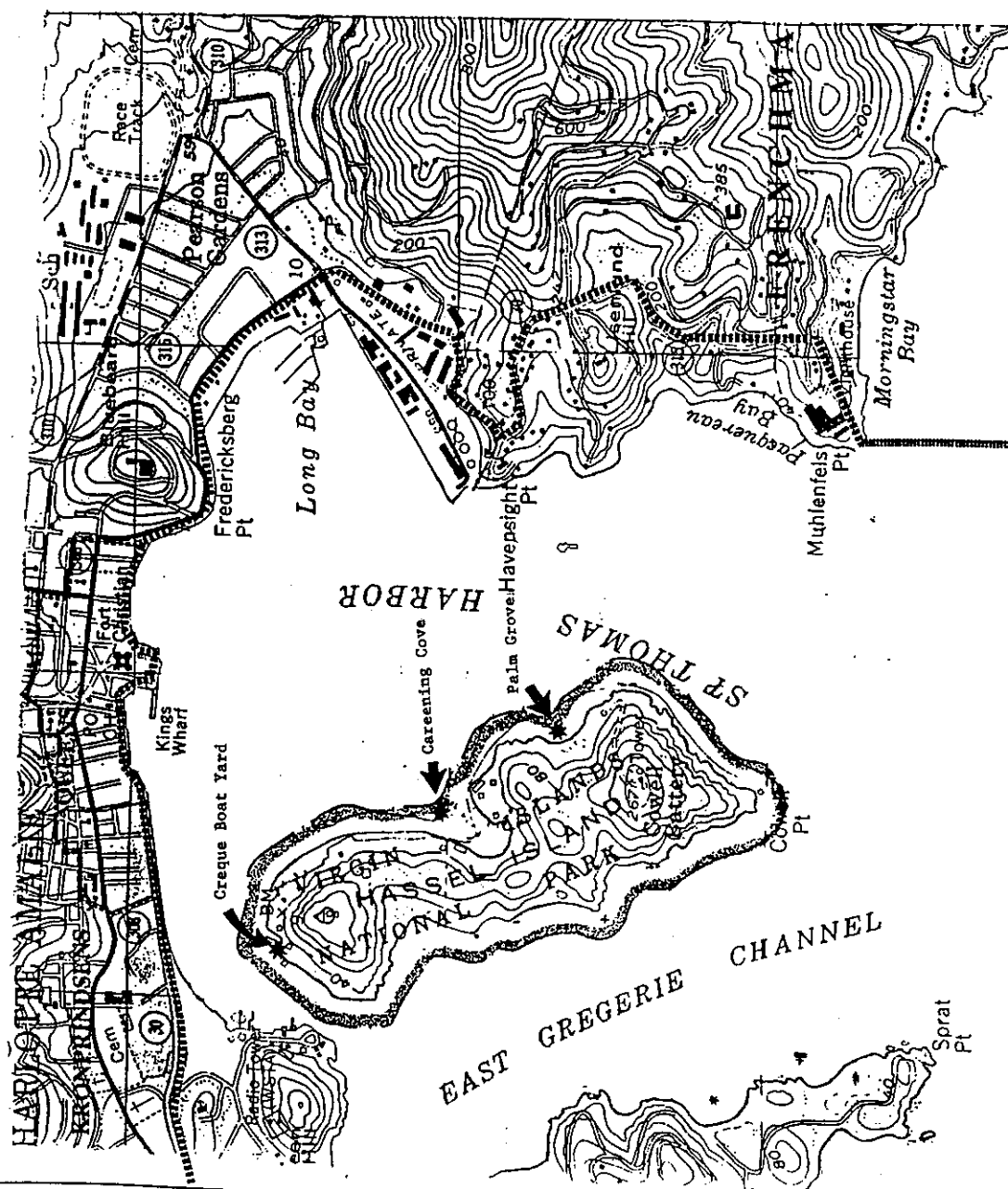


Figure 2a
APC Boundary Map (East)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

1000 0 1000 FEET

APC Boundary

ST. THOMAS HARBOR AND WATERFRONT (West)

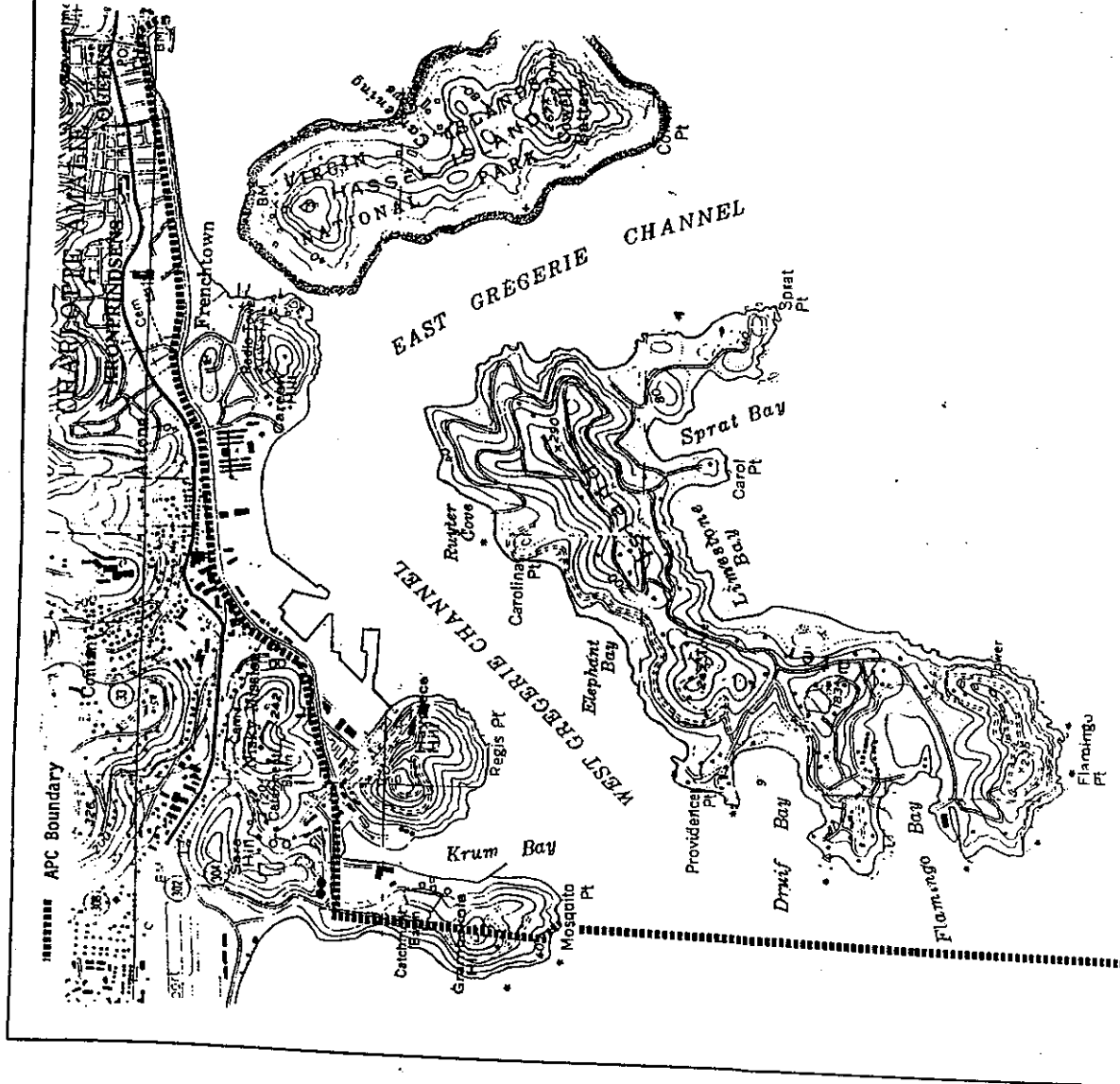


Figure 2b
APC Boundary Map (West)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

1000 0 1000 2000 FEET

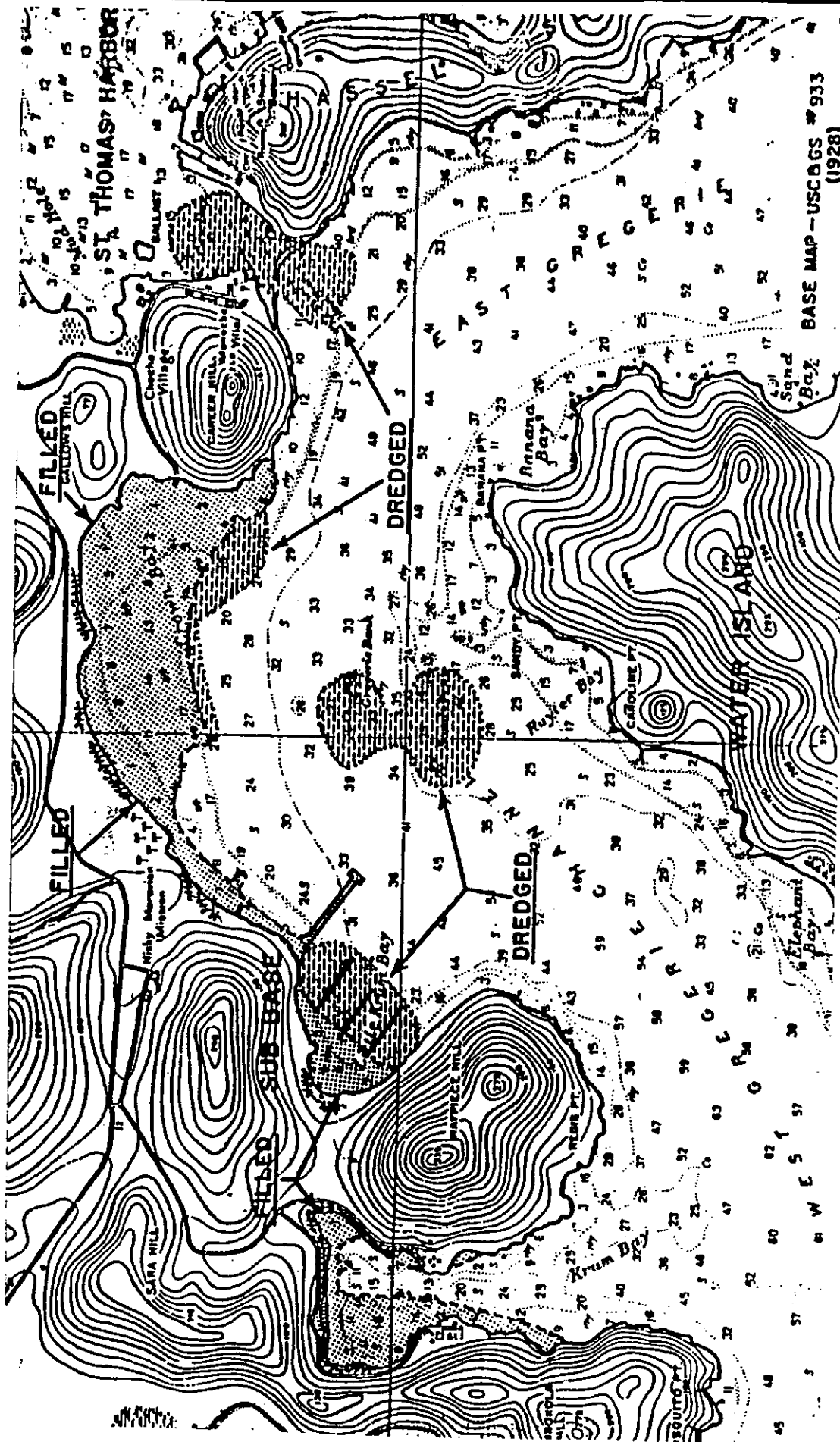


Figure 3
 Historic Dredge Sites
 Adapted from: Ragster, 1986
 Island Resources Foundation, 1993

ST. THOMAS HARBOR

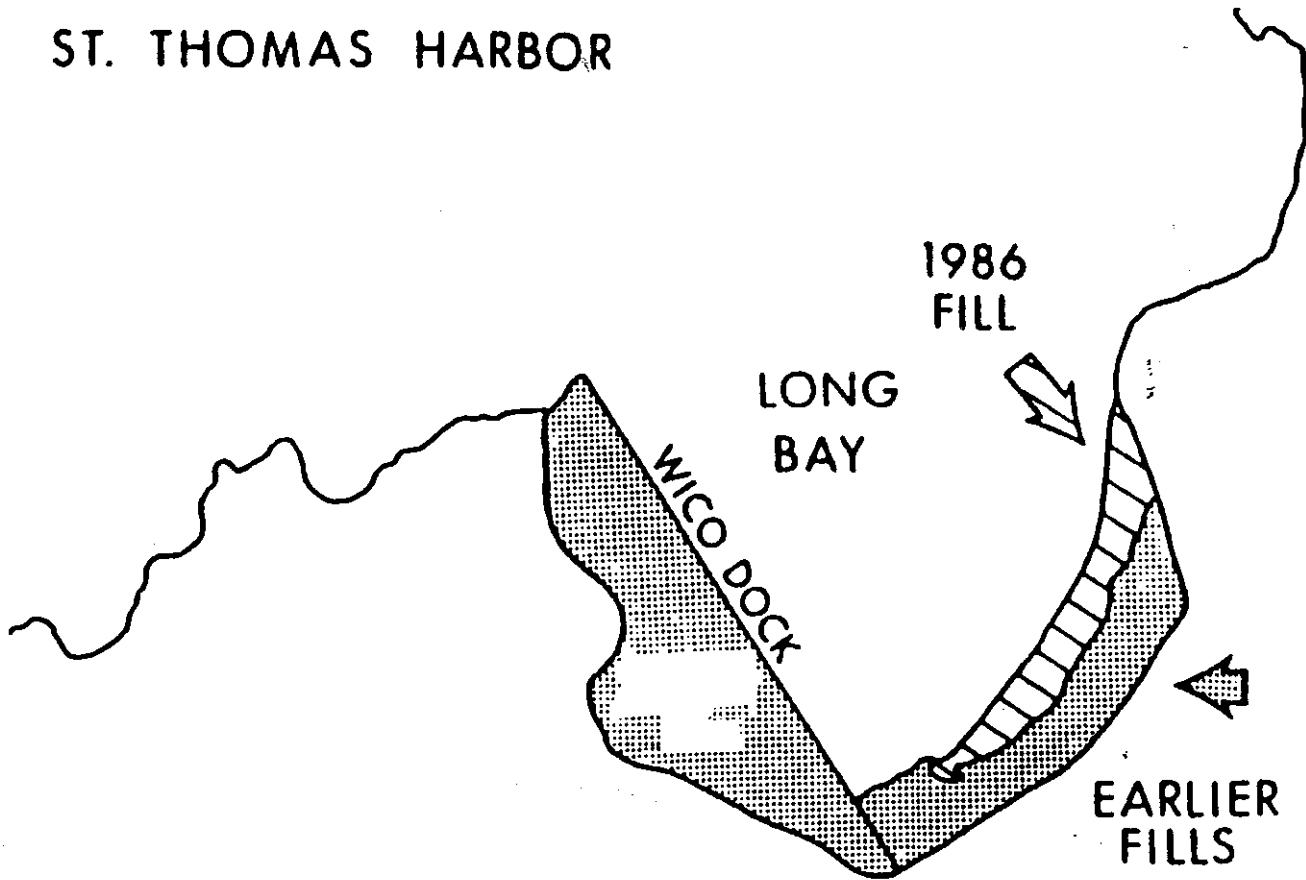


Figure 4
Long Bay Fill
Adapted from: Nixon, 1990
Island Resources Foundation, 1993

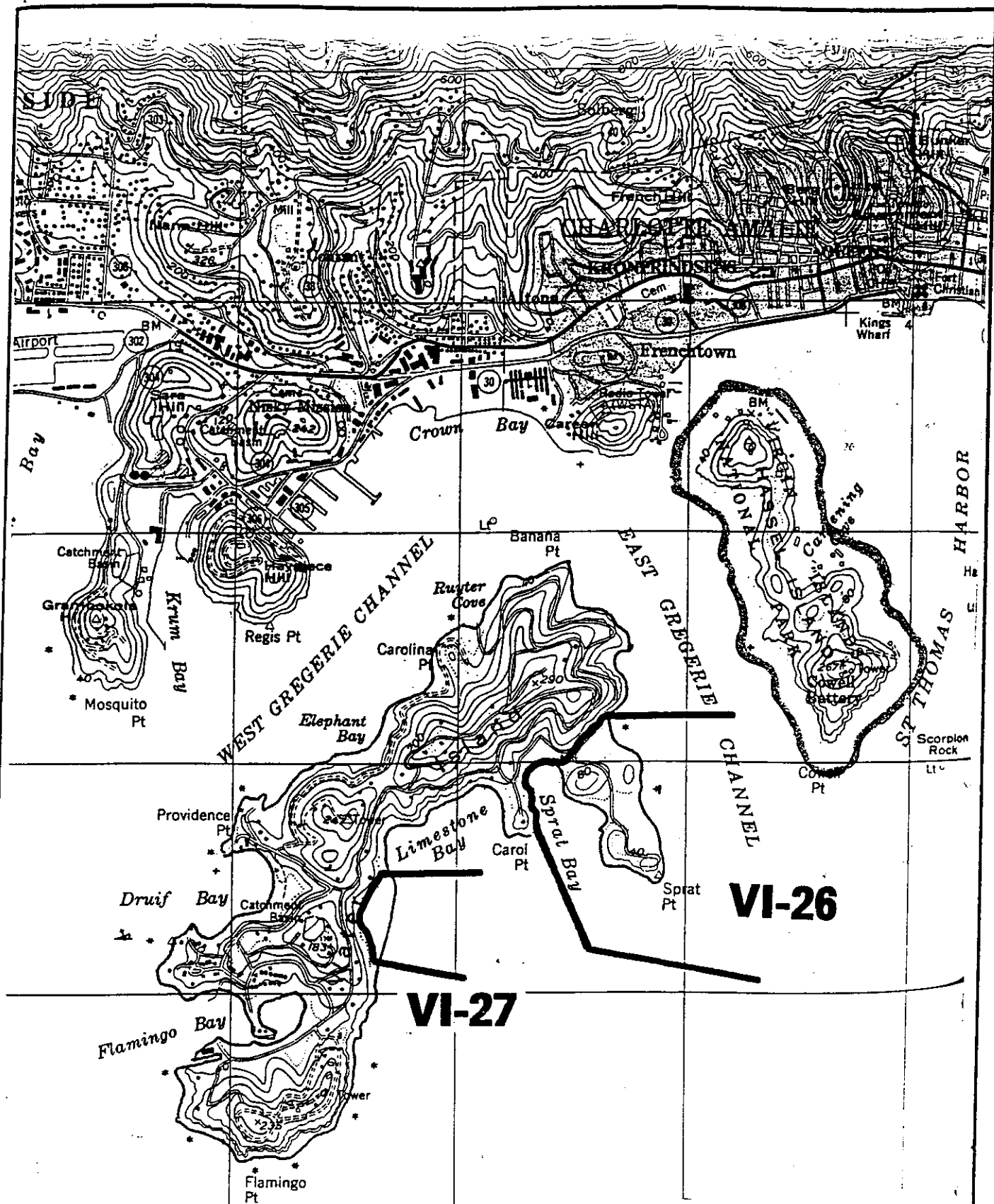


Figure 5
 Coastal Barrier Resources System
 Designated sites for St. Thomas
 Harbor and Waterfront
 Adapted from: USFWS, 1990
 Island Resources Foundation, 1993

ST. THOMAS HARBOR AND WATERFRONT

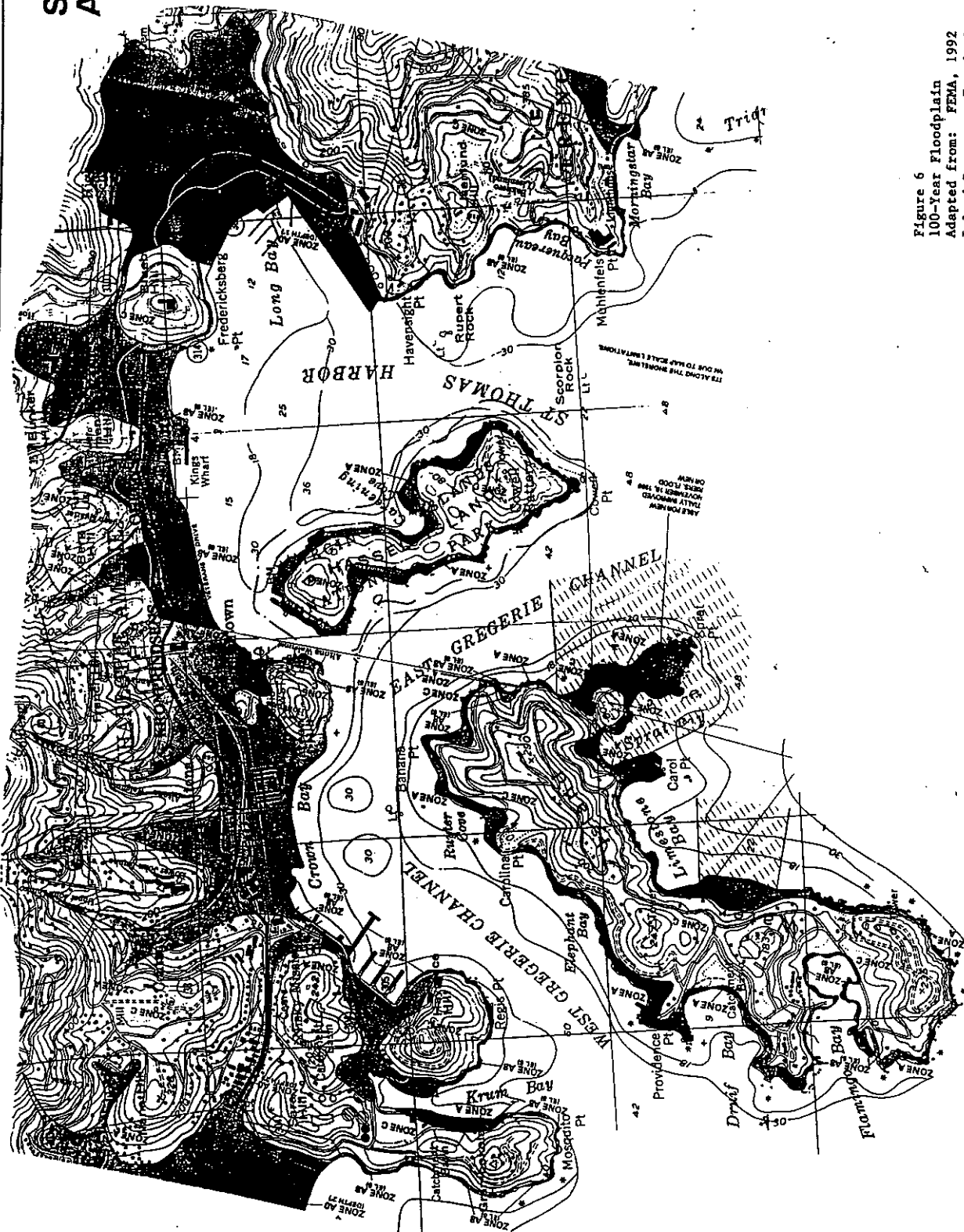


Figure 6
100-Year Floodplain
Adapted from: FEMA, 1992
Island Resources Foundation, 1993

FLOOD INSURANCE RATE MAP EFFECTIVE:
OCTOBER 19, 1990

10000 INSURANCE RATE MAP REVISIONS:

November 1, 1986 - to change special flood hazard areas.
March 18, 1987 - to add special flood hazard areas, and to change zone designations.
August 2, 1992 - to add undeveloped coastal barriers and otherwise protected areas.



Figure 7
Major Drainage Basins
Adapted from: BC&E, 1979
Island Resources Foundation, 1993

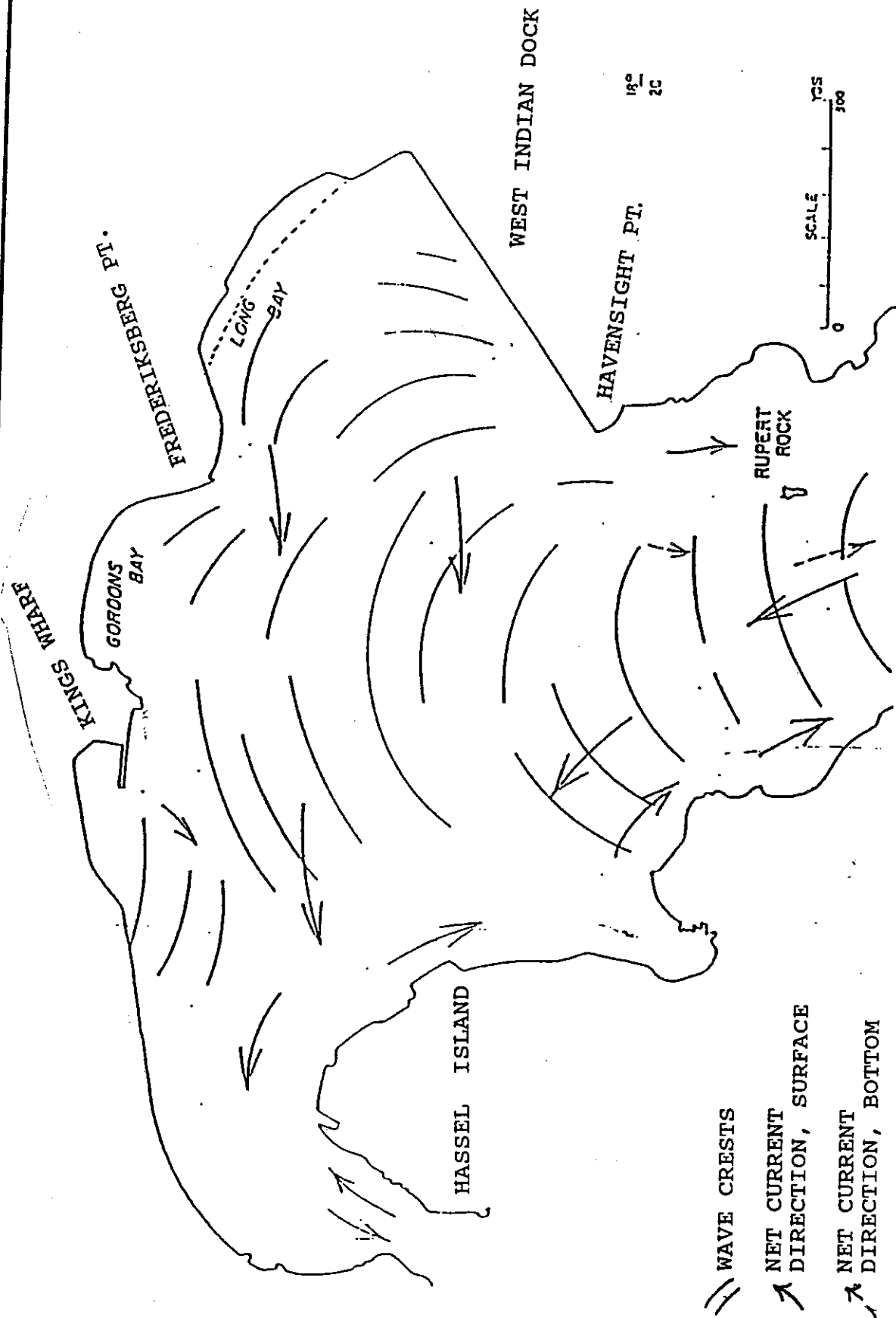


Figure 8
 Prevailing Currents
 Adapted from: Brill and Associates, 1991
 Island Resources Foundation, 1993

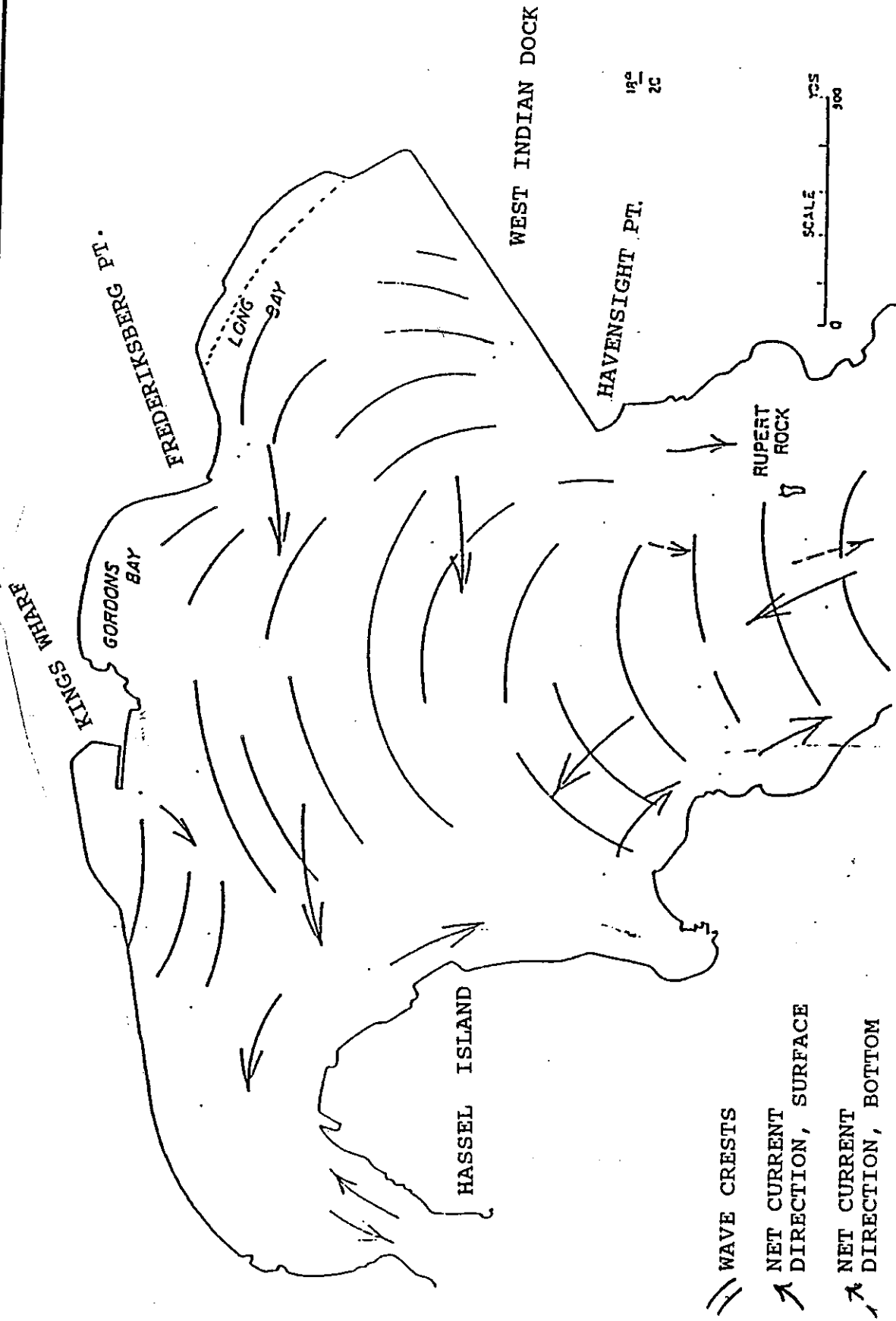


Figure 8

Prevailing Currents

Adapted from: Brill and Associates, 1991
Island Resources Foundation, 1993

ST. THOMAS HARBOR AND WATERFRONT (East)

PHYSICAL AND BIOLOGICAL FEATURES

- Coastal structures and rocky shores
- Exposed rocky shores & vertical seawalls
- Mixed sand and gravel beaches
- Gravel beaches and exposed riprap
- Mangroves (fringing shoreline)
- Seagrass beds; sea turtle grazing areas
- Marine birds (mainly; Royal tern, Sandwich tern and laughing gull)
- Marine birds/known breeding area (mainly; Red-billed tropicbird)
- Whales, dolphins, and manatee sited (infrequently)

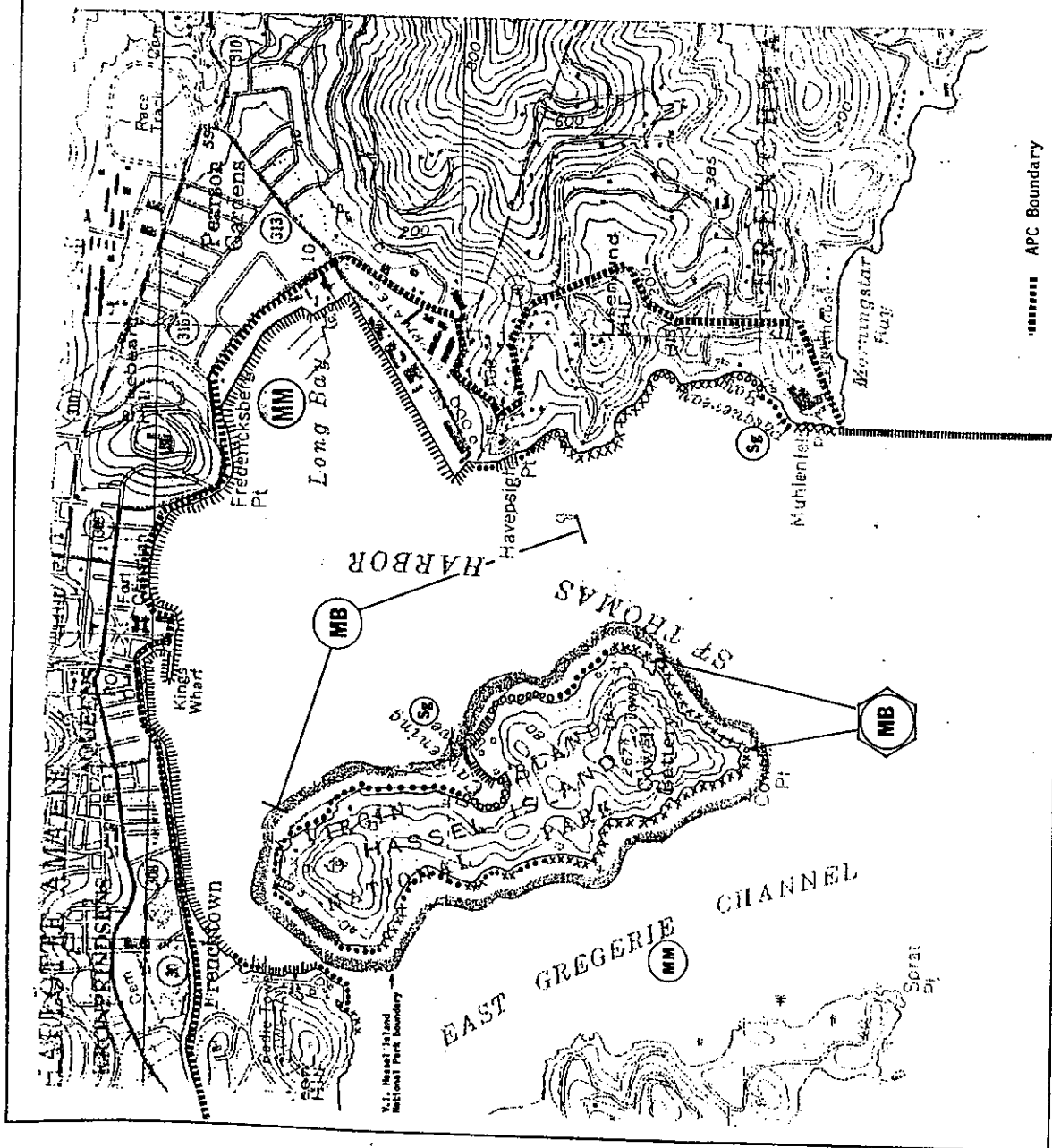














Figure 9a
Physical/Biological Environment (East)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

1000 0 1000 FEET

----- APC Boundary

ST. THOMAS HARBOR AND WATERFRONT (West)

PHYSICAL AND BIOLOGICAL FEATURES

-  Coastal structures and rocky shores
-  Exposed rocky shores & vertical seawalls
-  Fine- to medium-grained sand beaches
-  Gravel beaches and exposed riprap
-  Mangroves
-  Salt ponds/important wildlife habitat
-  Seagrass beds
-  Marine birds
(mainly; Magnificent frigatebird)
-  Marine birds
(mainly; Royal tern, Roseate tern,
Brown noddie and Laughing gull)
-  Marine birds/known breeding area
(mainly; Red-billed tropicbird)
-  Sea turtles
(mainly; Hawksbill)
-  Whales and dolphins sighted (infrequently)

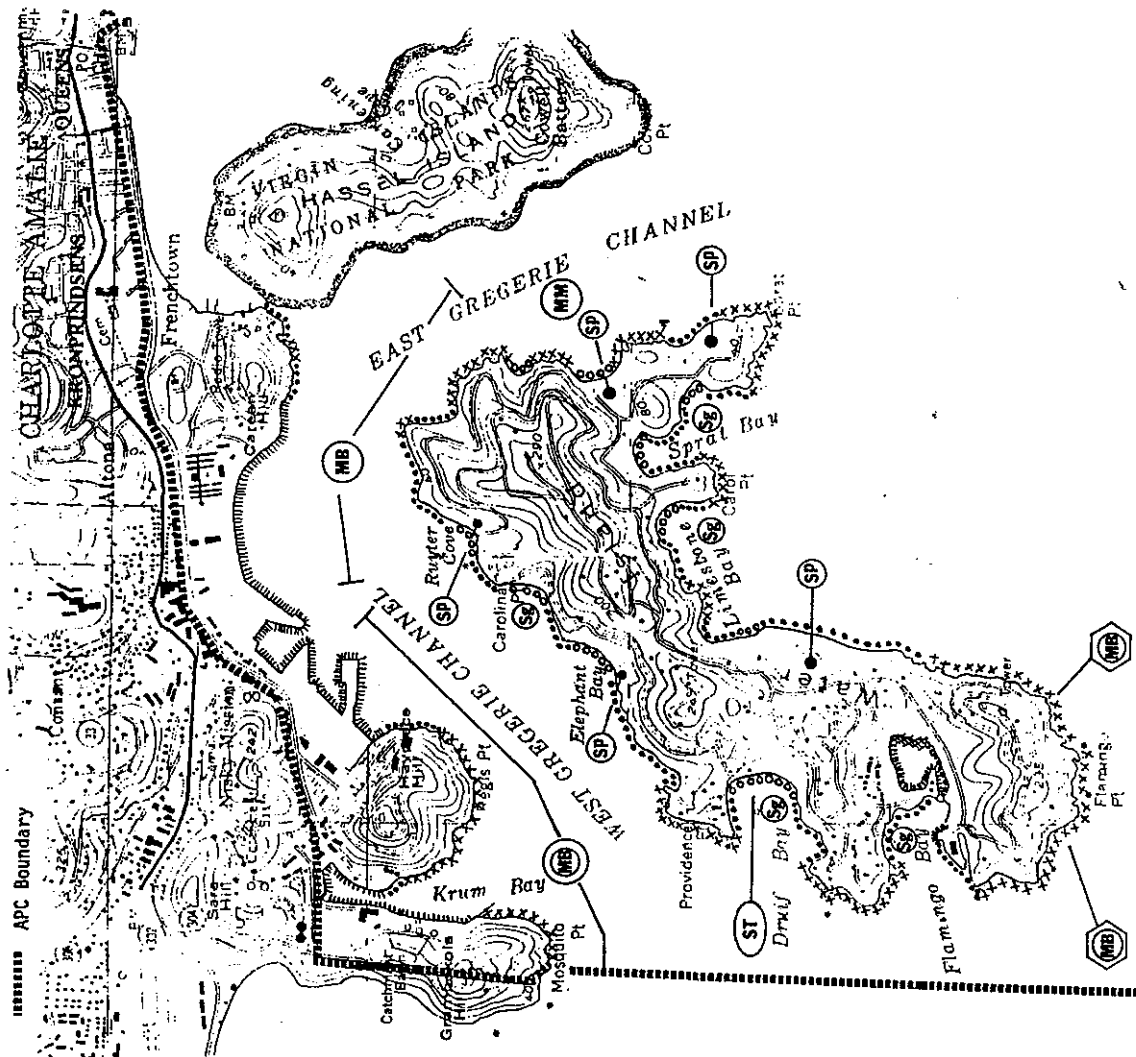
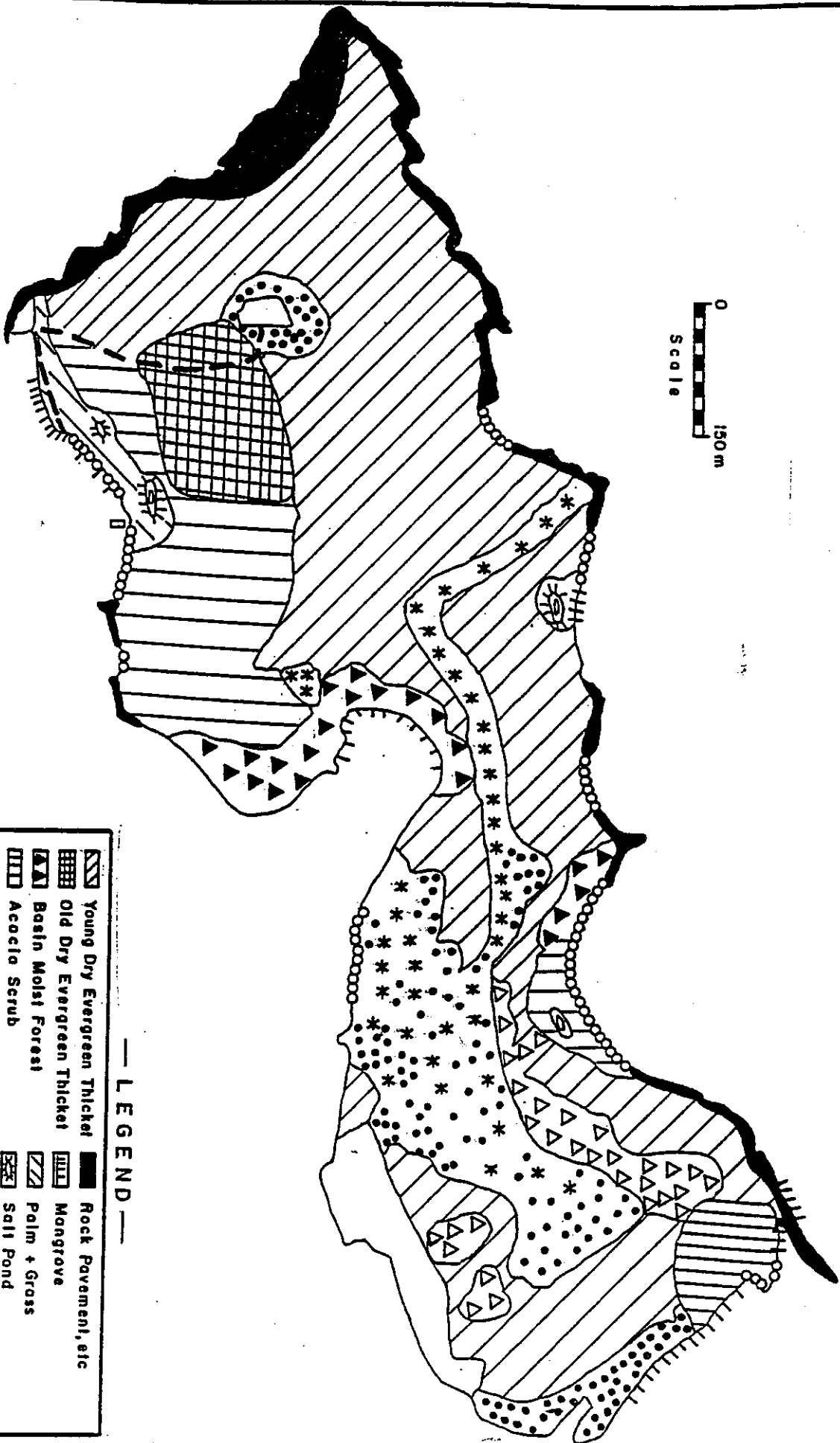
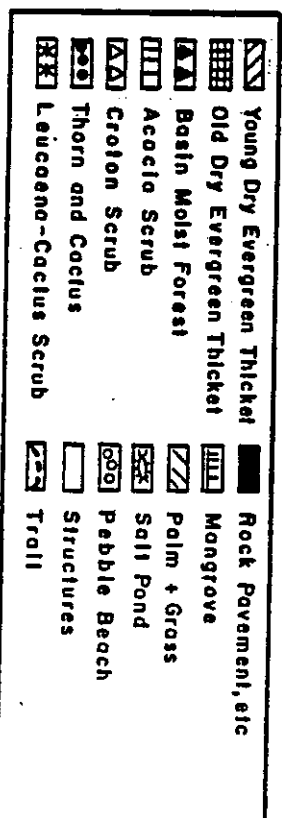
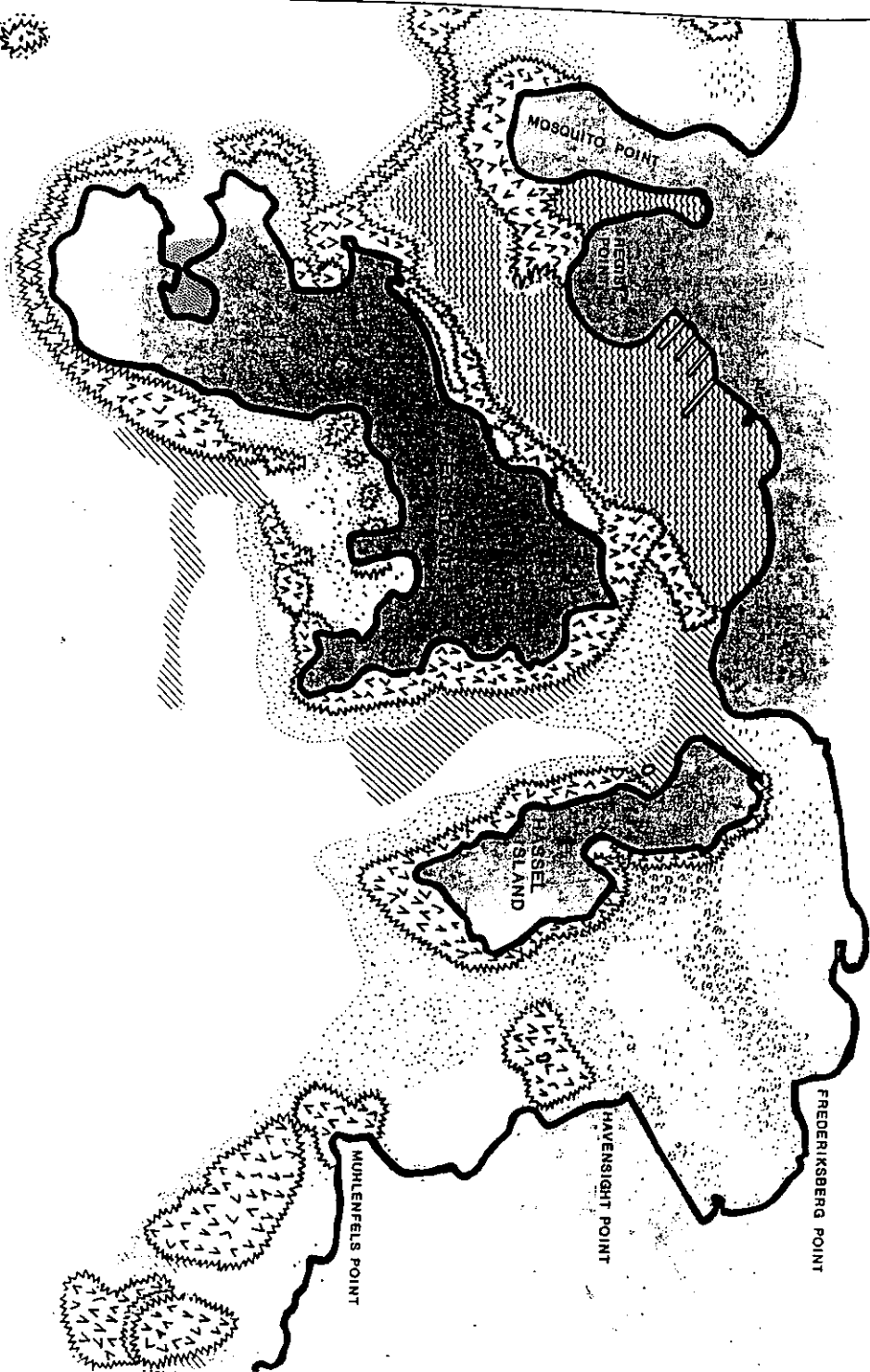


Figure 9b
Physical/Biological Environment (West)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

1000 0 1000 FEET

Figure 10
Vegetation of Hassel Island
Adapted from: Woodbury and Weaver, 1987
Island Resources Foundation, 1993





LEGEND

	FINE SEDIMENT
	<i>Thalassia</i> TURTLE GRASS
	<i>Syringodium</i> MANATEE GRASS
	<i>Halimeda-Pencilling</i> CALCIFIED GREEN ALGAE
	<i>Halophila</i> SEA GRASS
	HARD CORAL REEF
	<i>Gracilaria-Acanthophora</i> RED ALGAE
	CARBONATE SAND
	<i>Halodule</i> MARINE GRASS
	ALGAL PLAIN
	DEPAUPERATE SAND PLAIN

Figure 11
Benthic Communities
Adapted from: Olson, G. 1983
Island Resources Foundation, 1993

Legend
Historic
Control
District

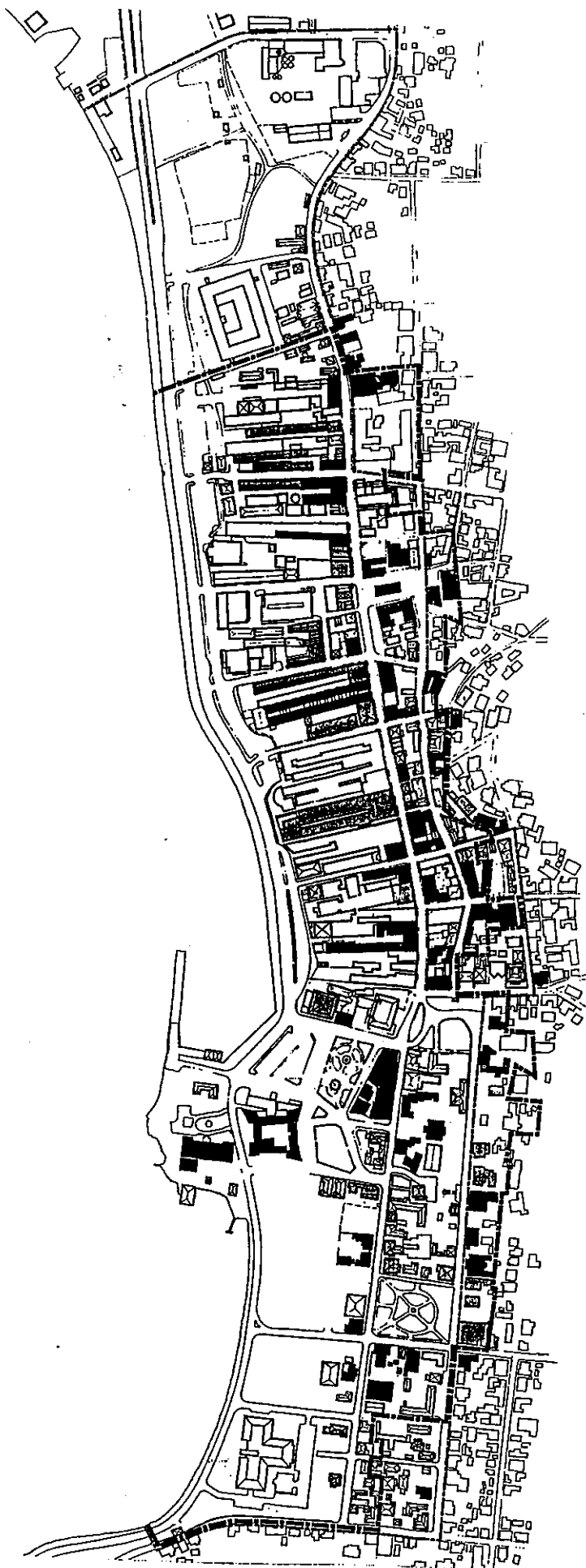


Figure 12
St. Thomas Historic District
Adapted from: deJongh and Associates, 1974
Island Resources Foundation, 1993

KEY:

- Area #1 - Yachts
- Area #2 - Greater than 150 feet
- Area #3 - Cruise ships
- Area #4 - Cruise Ships/Naval vessels

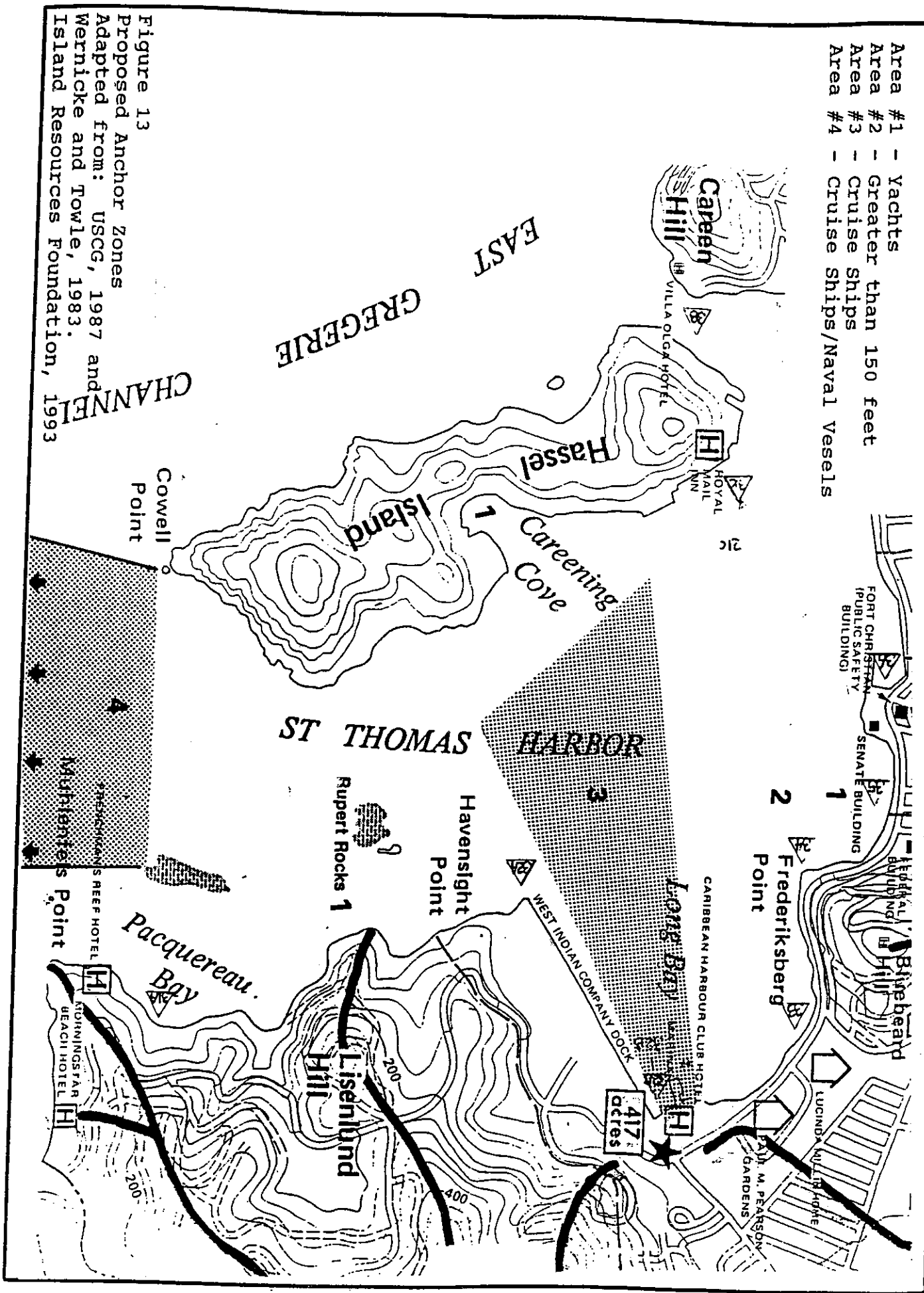


Figure 13

Proposed Anchor Zones

Adapted from: USCG, 1987 and Wernicke and Towle, 1983. Island Resources Foundation, 1993

ST. THOMAS HARBOR AND WATERFRONT (East)

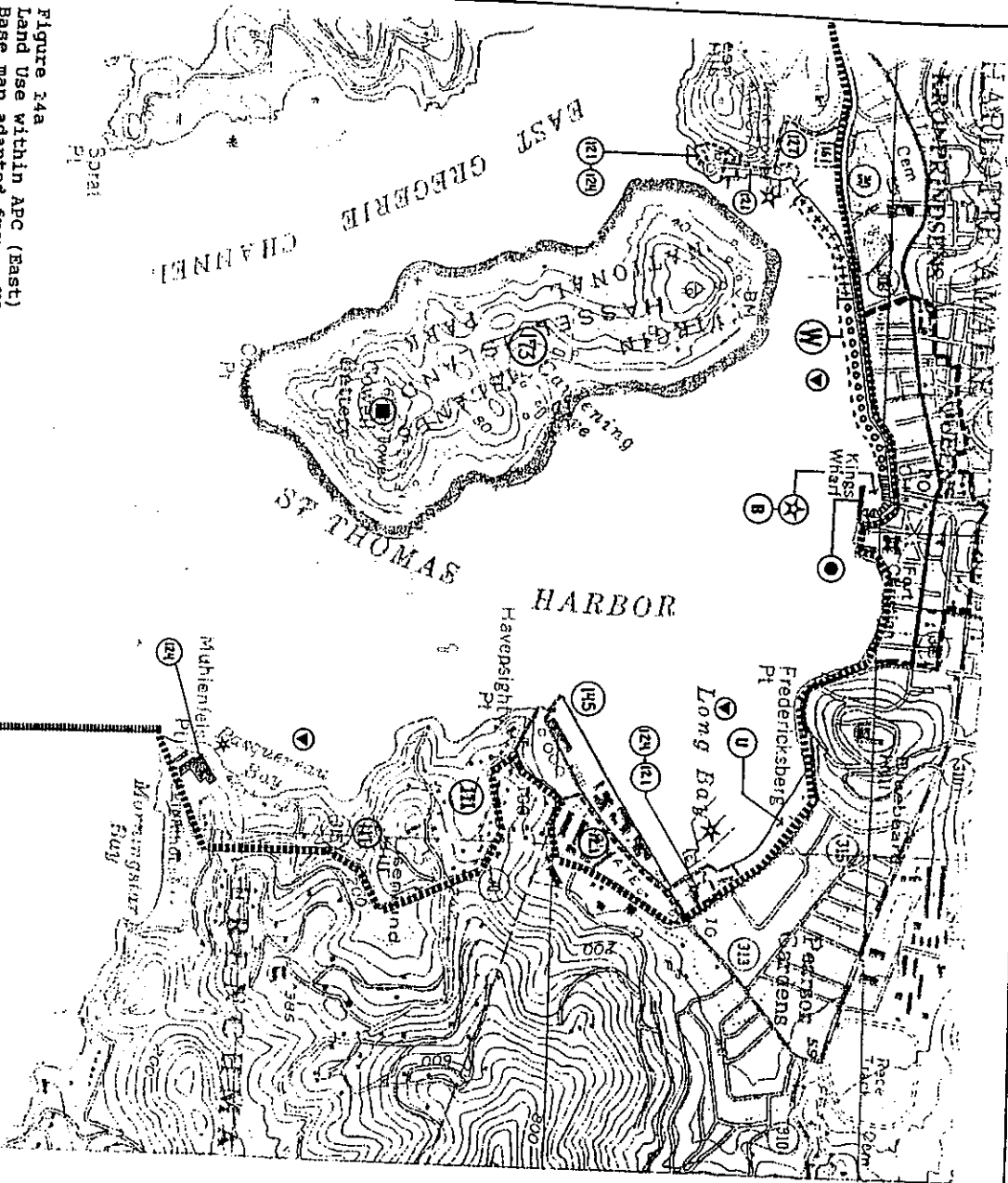
LAND USE

- Residential
 - 111 Low density
 - Commercial & Services
 - 121 Retail sales
 - 124 Hotel/Resort
 - 127 Mixed commercial & services
 - Transportation
 - 145 Cruise ship port facility
 - Institutional
 - 161 Educational facility (school)
 - Recreational
 - 173 Park (V.I. Hassel Is. National Park)
 - Other
 - 173 Marinas
 - Mooring areas
-
- Charlotte Amalie Historic District (boundary)
 - Old signal station (Port Authority)
 - Coast Guard dock
 - Small boat marina (port Authority); individual slips leased to owners of small trading vessels
 - Area along downtown waterfront owned/managed by Port Authority; includes the following generalized division of uses:
 - Fishing craft; small trading vessels
 - Inter-island/down island ferry vessels
 - Freight; larger trading vessels
 - Undeveloped

APC Boundary

1000 0 1000
FEET

Figure 24a
Land Use within APC (East)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993



ST. THOMAS HARBOR AND WATERFRONT (West)

LAND USE

Residential

111 Low density (single unit)

Commercial & services

121 Retail sales
124 Hotel/resort
127 Mixed commercial & services

Industrial

131 Light industrial
132 Heavy industrial

Transportation

145 Port facility

Communications

153 Transmission tower

Institutional

161 Educational facility
162 Governmental/administration

Recreational

173 Park (V.I. Hassel Is. National Park)

★ Marinas

★ Mooring/anchorage areas

Other

① Crown Bay waterfront
(owned/managed by Port Authority)

■ Small boat marina; some yachts; Coast Guard
oil spill equipment; caters to charter vessels

▨ Approx. 20 acres of fill with bulkhead; area
leased by Port Authority to several leaseholders

○○○ cargo vessels

② Small boat marine (leased); Water Island ferry
(when operating); parking & services available
Cruise ship dock, with marina operations to
west (Hanlover Marine)

1000 0 1000 FEET

Classification system adapted from: Leyland, 1961

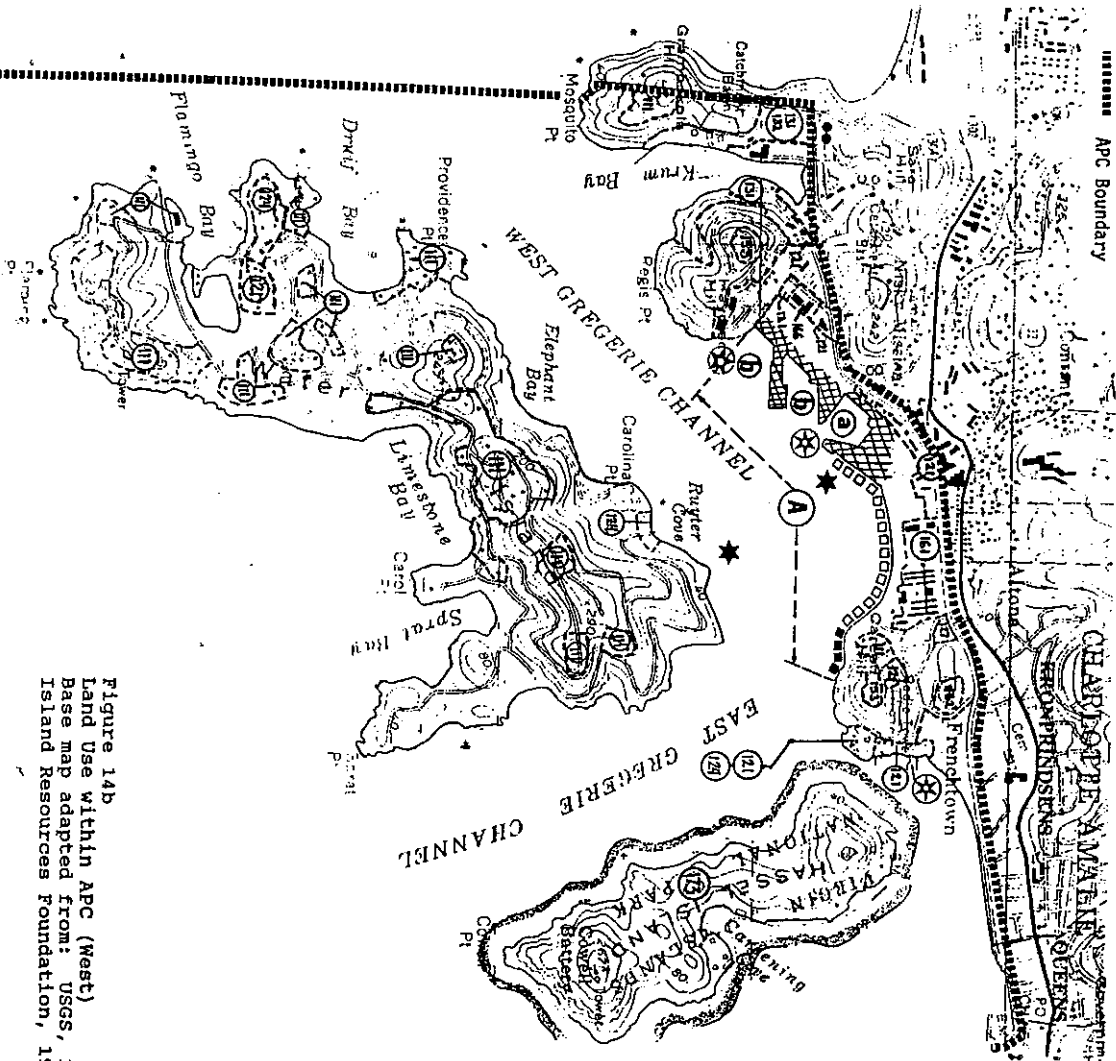


Figure 14b
Land Use within APC (West)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993

ST. THOMAS HARBOR AND WATERFRONT (East)

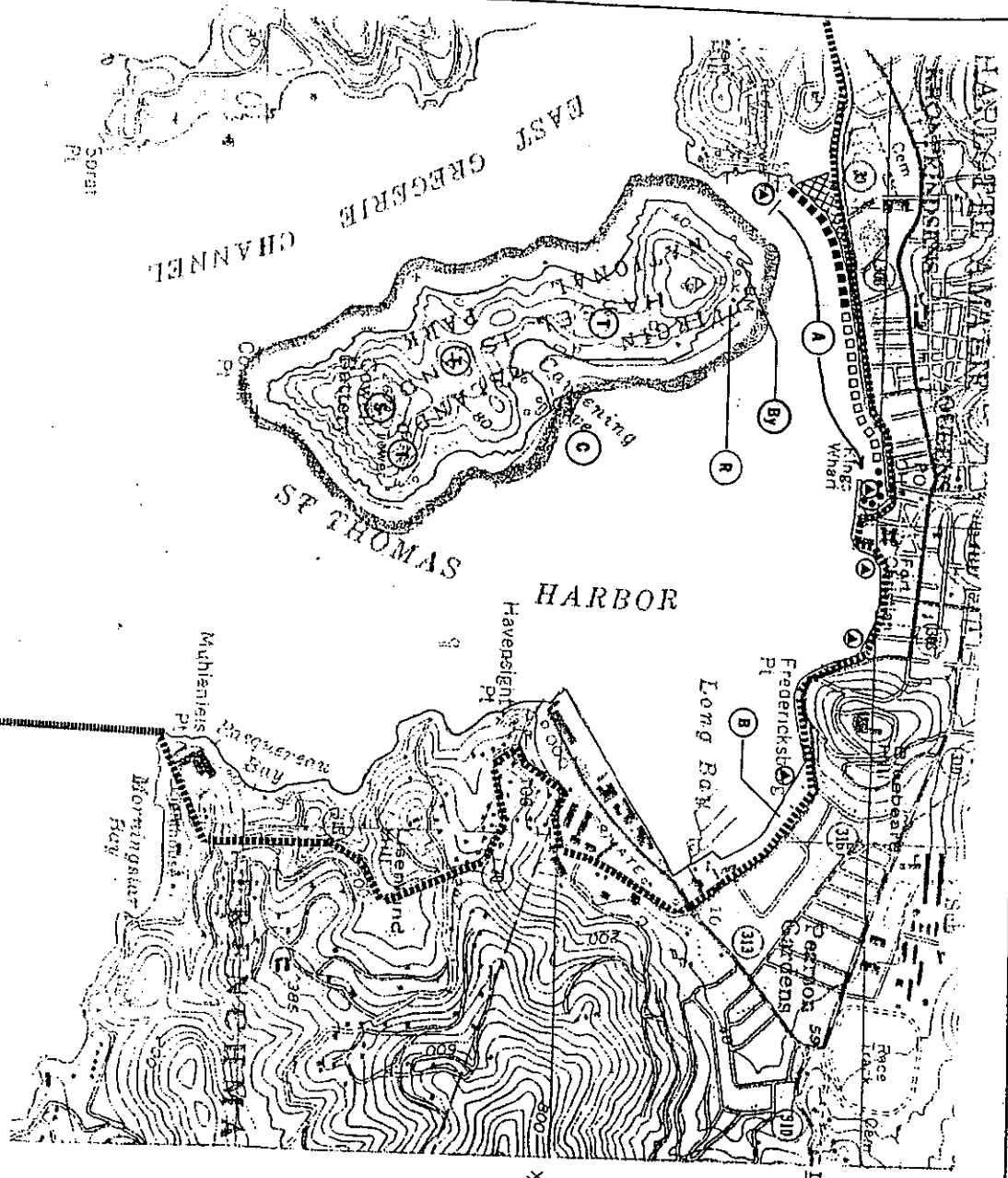
LAND USE/OPPORTUNITIES AND CONSTRAINTS

- (A) Active area along downtown waterfront owned/managed by Port Authority; includes the following generalized division of uses:
 - ... Fishing craft; small trading vessels
 - Inter-island/down island ferry vessels
 - ■ ■ Freight; larger trading vessels
- (B) Tortola wharf terminal; to begin construction in 1993 (services vessels destined for BVIs; sea plane terminal located nearby (behind))
- (C) Undeveloped open space - good potential for waterfront park (currently used as pedestrian walkway between cruise ship facility and downtown; also slated for major commercial development by WICO.
- (R) Royal Mail Inn - rehabilitation potential
- (C) Careening Cove-(dock) rehabilitation potential
- (By) Creque Boatyard - potential site for maritime training facilities and maritime museum
- (S) Signal tower - historic site
- (T) Ridgeline trail - needs improvement/interpretation
- (A) Sewage discharge (CSOs)

Figure 15a
Land Use/Opportunities and Constraints (East)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993



----- APC Boundary

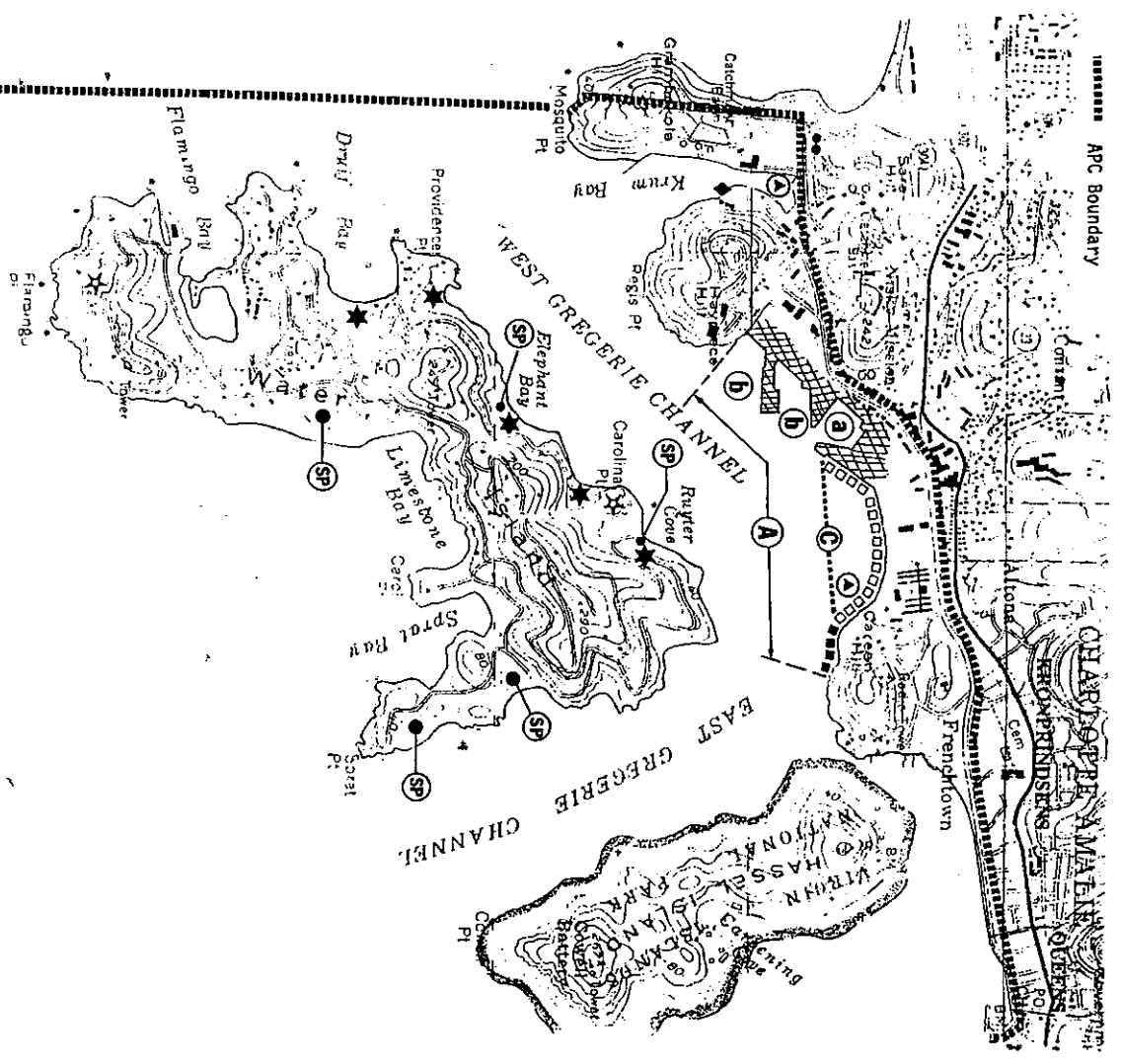


ST. THOMAS HARBOR AND WATERFRONT (West)

LAND USE/OPPORTUNITIES AND CONSTRAINTS

- (A) Active area along Crown Bay waterfront (owned/managed by Port Antigua)
- Small boat marina; some yachts; Coast Guard oil spill equipment; caters to charter vessels
- Approx. 20 acres of fill with bulkhead; area leased by Port Authority to several leaseholders
- Cargo vessels
- ② Small boat marina (leased); Water Island ferry (when operating); parking & services available
- ③ Cruise ship dock, with marine operations to west (Haulover Marina)
- ④ Conceptual plans for future expansion; dotted line indicates bulkheading; would allow more dock side space for deep draft vessels
- ★ Archaeological sites
- ☆ Historical sites
- SP Salt ponds / Important wildlife habitat
- ⑦ Sewage discharge (CSOs)
- ◆ Derelict vessels

Figure 15b
Land Use/Opportunities and Constraints (West)
Base map adapted from: USGS, 1982
Island Resources Foundation, 1993



One-Way Triple-Loop Traffic Plan Charlotte Amalie, St. Thomas

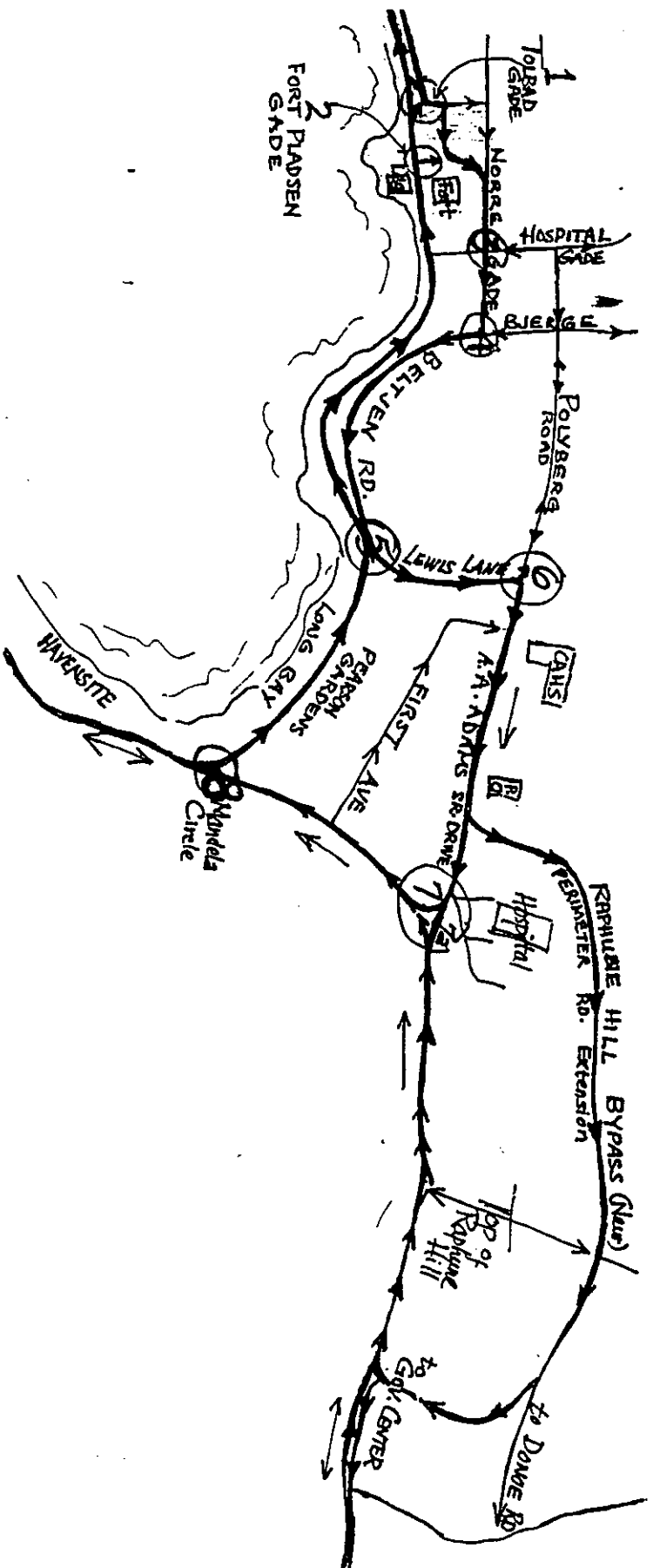


Figure 16
Proposed One-Way Loop
Adapted from: League of
Women Voters, USVI, 1991
Island Resources Foundation, 1993

U.S. Virgin Island
Zoning Codes

- A-1 Agricultural District
- A-2 Agricultural District
- R-1 Residence Low Density
- R-2 Residence Low Density
- R-3 Residence Medium Density
- R-4 Residence Medium Density
- R-5 Residence High Density
- B-1 Business Central Business District
- B-2 Business Secondary
- B-3 Business Scattered
- B-4 Business Residential
- C- Commercial
- I-1 Industry Heavy
- I-2 Industry Light
- W-1 Waterfront Pleasure
- W-2 Waterfront Commercial-Industrial
- P- Public

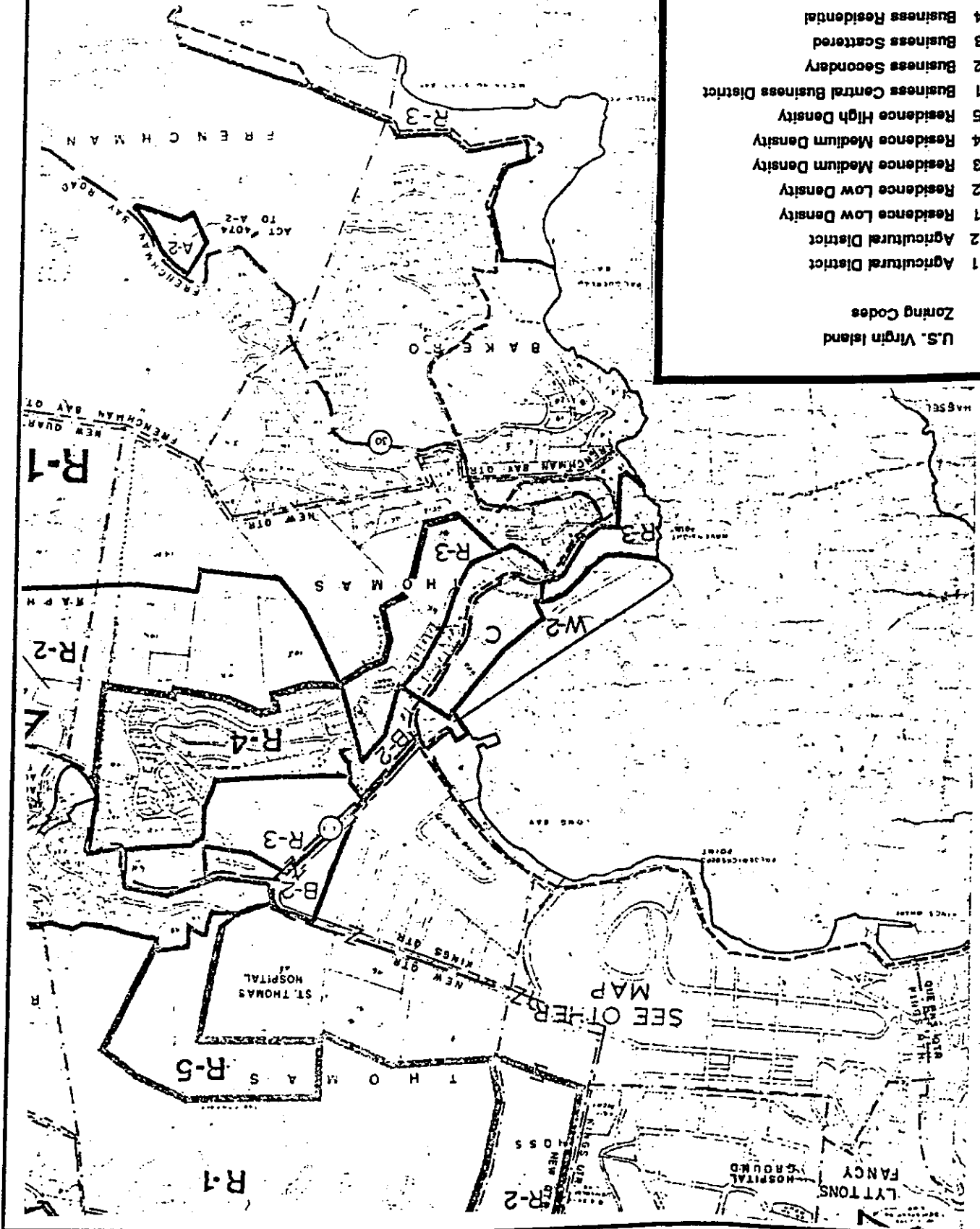


Figure 17a
Zoning Map
Adapted from: Real Estate
Data Inc., 1987
Island Resources Foundation, 1993

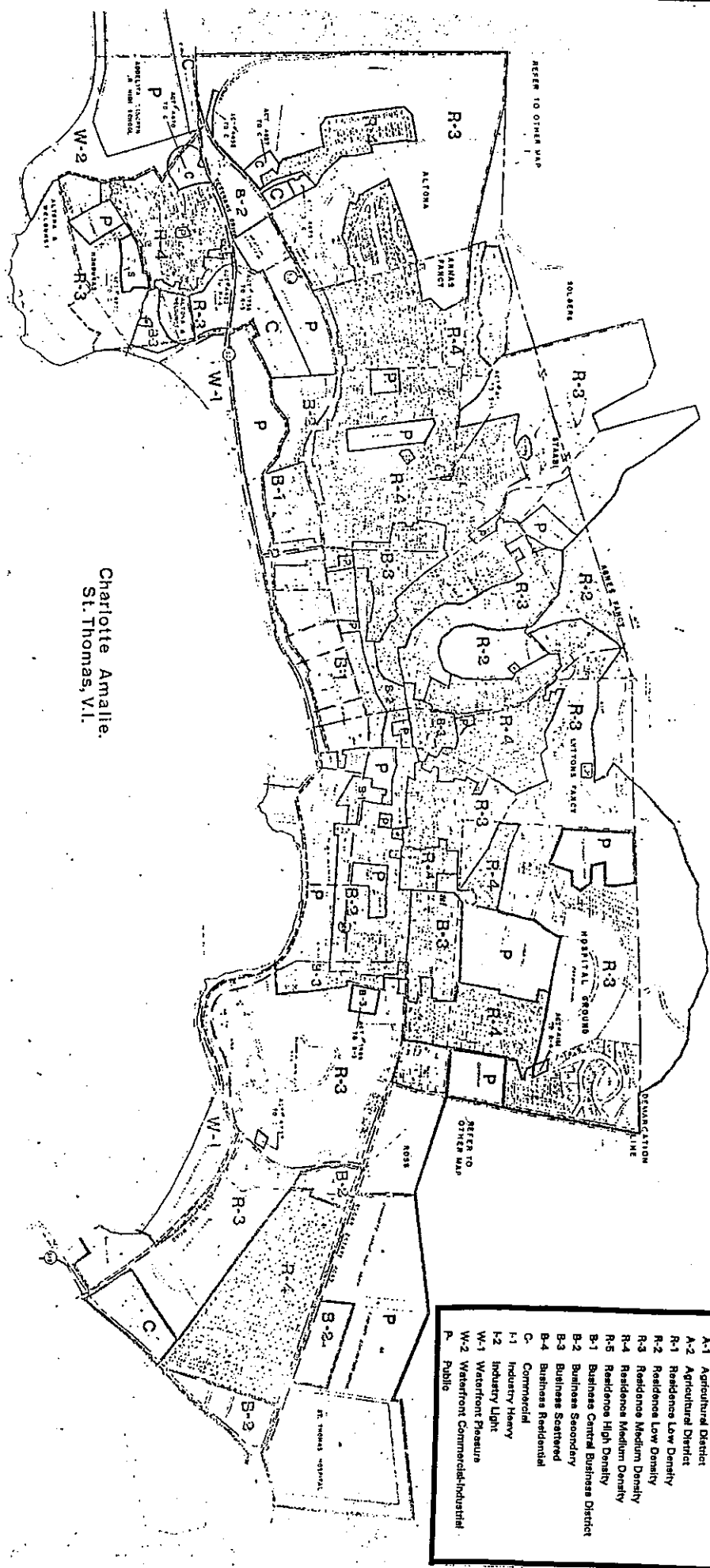
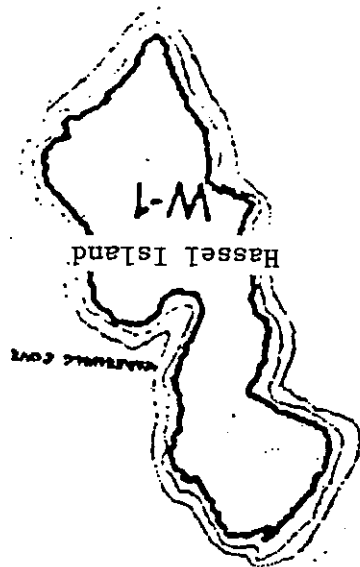


Figure 17b
Zoning Map
Adapted from: Real Estate
Data Inc., 1987
Island Resources Foundation, 1993

U.S. Virgin Island
Zoning Codes

A-1	Agricultural District
A-2	Agricultural District
R-1	Residence Low Density
R-2	Residence Low Density
R-3	Residence Medium Density
R-4	Residence Medium Density
R-5	Residence High Density
B-1	Business Central Business District
B-2	Business Secondary
B-3	Business Scattered
B-4	Business Residential
C-	Commercial
I-1	Industry Heavy
I-2	Industry Light
W-1	Waterfront Pleasure
W-2	Waterfront Commercial-Industrial
P-	Public



Adapted from: Real Estate
Data Inc., 1987

Island Resources Foundation, 1993

- U.S. Virgin Island
Zoning Codes
- A-1 Agricultural District
 - A-2 Agricultural District
 - R-1 Residence Low Density
 - R-2 Residence Low Density
 - R-3 Residence Medium Density
 - R-4 Residence Medium Density
 - R-5 Residence High Density
 - B-1 Business Central Business District
 - B-2 Business Secondary
 - B-3 Business Scattered
 - B-4 Business Residential
 - C- Commercial
 - I-1 Industry Heavy
 - I-2 Industry Light
 - W-1 Waterfront Pleasure
 - W-2 Waterfront Commercial-Industrial
 - P- Public



Figure 17d
Zoning Map
Adapted from: Reel Estate
Data Inc., 1987
Island Resources Foundation, 1993

